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Geographic Index as Direction for Cases of Malaria Disease in the Archipelago of East Nusa Tenggara Year 2013

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Abstract: ***Background: Based on Indonesian Health Basic Research 2007) In Indonesia, East Nusa Tenggara is the province with the highest number of malaria victims after Papua. East Nusa Tenggara Health Department 2006 reported number of Annual Malaria Incidence (AMI) reached 145,43 % and Annual Parasite Incidence (API) is 29, 56%, year 2007 observed Annual Parasite Incidence (API) 119 %, whereas, Annual Parasite Incidence (API) is 29 %, year 2009 Annual Parasite Incidence (API) 31 per 1000 population. Method: Type of research is analytical observational with cross sectional study design. Cross sectional study with aim of designing geographic index for health cadres to the early discovering of malaria cases in the Archipelago of East Nusa Tenggara. For Community Based Surveillance (CBS) capacity building is improving surveillance activities in the society level. Result: Relation between beaches (0,043<a 0,05), farms (0,004 <a 0,05), bushes (0,003 <a 0,05), small trees (0,024 <a 0,05), savanna (0,003 <a 0,05) and ponds (0,001 <a 0,05) give impact to the increase of malaria disease cases every time. This accuracy shown with the result of laboratory test such as; with cut off geographical index scores for archipelago malaria ≥ 1,386 predicted persons or communities in farms areas or savannas inside their body lives plasmodium or malaria disease if found scores index <-1,386 it means the person does not infected by malaria disease. If the sensitivity is 82,5%, it means that the index if used to observe population of 100 persons in the archipelago area with malaria endemic at geographical condition which consist of farms and savanna achieved 82, 5 persons who are victims of malaria, whether from the result of clinical test or diagnostic test with bold drop. While specify is 32,4% if the population are 100 persons who are taken bold drop or clinical and at farms and savannas' areas approved 32, 4 persons have not been suffering from malaria disease. Conclusion: Many people will become victims of malaria if inside those small islands have main base for vectors such as; puddle or lagoon, dike, small trees, farm and beach who are victims of malaria in remote areas because possibility of not receive maximal service for health because of difficulty in distributing Rapid Diagnostic Test.***

Keywords: Geographical Index, As Indicators of Malaria Cases, in the Archipelagos

1. Introduction

Malaria disease is the most dominant infectious disease in the tropical and sub-tropical areas and it can caused more than billions human mortality every year. Around period between year 2000-2009 in the areas of South East Asia, malaria incidence revolve between 2,16-2,83 billion people with mortality numbers between 3188-6978. Slide positive rate (SPR) revolve between 2, 28-2, 98 % is *P. falciparum.*

Annual Parasite incidence (API) revolves about 1.71-2, 21 %. It means that from the result of laboratory test positive numbers of victims who have under the test if divided with all number of slides which inspected found 1,71-2,21 % positive available plasmodium inside blood served while malaria mortality rate (MMR/100.000) between 0,25-0,50. It means that from malaria cases happened on society population in South East Asia the mortality is 0,25-0,50 per 100.000 populations with malaria risks (WHO, 2011).

Malaria in Indonesia is found around the year and still many malaria cases are not diagnosed in which sometimes happen extraordinary cases in line with households' health survey in year 2001 available 15 billion malaria cases with 38.000 mortality every year. It is predicted about 35 % Indonesia population live in areas that infected by malaria. From 484 districts/municipalities in Indonesia, 338 districts are areas with malaria endemics (Soedarto, 2011).

The most important of malaria risks factors which related with mosquitoes comportments involve efforts in searching food, inhabitants and rest which called preference, this aspects involve biting human (*Anthrophily*) or other animals (*zoophile*); searching for host and rest outside rooms (*exophily*), or inside rooms (*Endophily*). Factors are contributed for malaria transmission include mosquitoes density, association of habitants, ability of vectors, afternoon activities pattern and habits of searching for human blood/feeding particularly tropical areas in South East Asia. Knowledge about time and location of mosquitoes in searching for human blood is an important action for a proper planning in preventing malaria. For instance, using nets maybe effective in areas with species are known biting at night and inside rooms (Indonesian Health Department , 2007 [a]).

The disparity of health service in small islands when in season of weaving caused by East wind or West wind, health services in small islands forced to off because small boats are not able to docked. In this condition even logistics, medicines, vaccines, and staffs' visits to the small islands cannot be done in which those islands are totally located or isolated (Achmadi, UF, 2008). In Indonesia Malaria is one of problems for those who are living in the archipelago such as Riau, North Maluku, Maluku is better to receive logistics or malaria prevention by participation of villages' malaria observers. It will be very effective and able to prevent malaria. This case is evidential in Ternate after villagers' malaria observers worked a year almost have not had job anymore because almost no more malaria (Republic of Indonesia Health Department, General Director.P2PL, 2006).

Accomplishing surveillance system in the districts/ municipalities shows that data collection aspect through involving society seldom or almost no participation in this

activity. Other than that, the result of regional health research (Basic Health Research 2010) shows that high numbers of new malaria cases in the level of province, East Nusa Tenggara included as the highest after Papua that is 117,5%. For blood test of malaria in very close health facility with society is Village Post for Health is very low (0,4%). It means that health services in the village level only treatment based on clinical indications without laboratory confirmation.

East Nusa Tenggara Province is an archipelago area with many health facilities such as 326 Center of Health for the Society and 890 subs Centers of Health for the Society spread all around archipelago. However, generally it done surveillance activity for malaria passively and totally or generally are not able to observe all cases happened in the working area, even in small islands or isolated areas not yet optimally detected malaria cases. For health analyst or microscopes staff in East Nusa Tenggara the ratio of Medical Technicians 9,6 per 100,000. It means that many Center of Health for Society do not have it in which available limitation in detecting malaria in left behind working area (Health Basic Research, 2007).

The Research results of Lukman Hakim, Rohmansyah DW (2009) held with judgment from Village Post for Malaria and Survey of KAP society known that form of *Community Based Surveillance* (CBS) that its accomplish done by cadres of Village Post for Malaria. Before itsaccomplished, it has to undergo community-based surveillance toward Village Post for Malaria cadres that will continue progressive formation by related department. Survey that more approximately is done by Villages Post of Health for Malaria cadres is observation toward malaria victims and Anopheles sp. Larva in main inhabitants.

Based on the previous study in Adonara and Lembata islands it can be explained that Adonara island generally detected through *Rapid Diagnostic Test* and it achieved dominant plasmodium is P.vivax (Incidental Global Fund Aid) year 2008-2010 means malaria spreading caused by complex factor, such as; influenced by local character of areas, including different ecological areas. Geographically, Adonara Island is counted as tropical climate area that divided in some specific ecological places and become locus of anopheles mosquitoes for multiplying. For instance, rice field environment, mountain (Ile Boleng), hills (Seburi Hill), and beaches that surround Adonaraisland that have different tall and kinds of vegetations. Moreover, malaria spreading is caused by other factor such environment changes, vectors, social-cultural of society, resistance of medicines and access for health services.

It can be analyzed that possible locus for breeding place or resting that become risk factor of many Center of Health for Society with trending kinds of high plasmodium and existed indigenous cases. One person (victim) can be infected by more than one plasmodium; this infectious *P. Falciparum* with *P. Vivax*. Mixture infectious is usually available in the area with higher infectious (transmission rate). More less 98 % from available blood (SD) is positive at microscopic test found P. Falciparum species and P. Vivax. Why? It is because *P. Malaria and P. Ovale* species is seldom to be found (Susana, 2005).

Malaria spreading in Lembata Island can be predicted as an impact of complex factor, such as influenced by local character of areas, including different specific ecological area and become proper multiplying places for anopheles mosquitoes. Lembata Island has hills and valleys, mountains and beaches with mangrove tree (Bacau) for forest or ponds, river mouth that is locus for female anopheles mosquitoes.

The improvement of clinical malaria index can adjust with vigilant village and the present of Villages Post of Health (Poskesdes). It can defined that Vigilant village is a condition of communities or villages which have ability in discover the present issues then make plan design and take action based on resources and always alert to face health issues, disasters and emergency situation. One of action form of Village Post of Health's cadres is self alert survey which called SMD or Self Alert Observation which called TMD or called also *community Self Survey (CSS)* which aim to improve people ability to do community Self Survey for their village. This survey should be done by the principles of local villages with the guidance of health workers. By this, it is hoped that they aware with issues that their village is faced. Itis Include constructing village post for health as effort to proximate basic health services toward villagers (the Republic of Indonesian Health Department, 2009).

2. Materials and Method

Kind of research is analytical observation with cross sectional study design. Cross sectional study is epidemiology study design that analyzes the relation of diseases and presentation or research factors throughout observing presentation status and synchronous diseases on individuals from solitary population, at the same time. This prime peculiar design is a presentation and disease status measured at the same time. These studies will proceed at the same time. In this cross section study design the researcher pictures frequency and the typical of diseases and factors presentation at any certain population. Data consequence resulted is the prevalence, not incidence (Murti B., 2003). Therefore this cross sectional study also called as prevalence study (Klein Baum et.all, 1982, in Murti B. 2010).

Cross sectional research is epidemiological study that learns upon prevalence, distribution, relation between diseases with presentation of research factors throughout observing health status synchronous at a time from any population and the research subject status at the time of data collection.

This phase is responds to aim of indicator development that proceeded by model of mapping geographical index relation with malaria case in the East Nusa Tenggara Province Archipelago. The clinical index determination for malaria in the archipelago areas through research development upon relation between all variables such as; environment factors as like rainfall rate, temperature, dampness, steppe, savanna, kinds of anopheles species (secondary data) and population mobility in the East Nusa Tenggara archipelago.

Population and Sample of the Research

Population
This research involves all fever patients in the working places of Health Center for the Society that exists in small islands in East Nusa Tenggara Province. Population determined based on areas of work of Health Center for Society that exist in the archipelago that involves sub-districts or villages that have malaria cases. Number of malaria cases in island taken as sample can be categorized as area with *High Case Incidence* (HCI) and *Low Case Incidence* (LCI).

Sample
Sample can be achieved from a person with disease at the area with high and low cases in small islands which fulfill requirements of inclusion, such as; the mentioned malaria cases will be taken blood sample that will be used for test using rapid diagnostic test method and bold test. The big sample needed is these two kinds of tests for positive and negative plasmodium identification. In order to determine sample at every Center of Health for Society counted with formula (WHO; Limeshow), then respondents are 428 persons.

Time and Location of Research
The research will be done in the isolated archipelago of East Nusa Tenggara Province such as; Lembata and Adonara islands. Based on the available data it shows that it happens an extraordinary malaria cases and the high of malaria cases happen almost every year and become endemics.

Time: the research had been held on last April until August 2012.

Research Variable

Variable Dependent: Malaria cases; is for testing results used result standard laboratory test with bold test and RDT.
Variable Independent: Environment: Geographical condition; beaches, hills, rice field, farms, slipping areas, valleys, steppe, savanna, lawns, bushes, lagoon, big trees, small trees, mountains, dikes, rivers, water sources conservation.

Data Analysis
Uni-variant Analysis; this analysis is to achieved general description throughout describing distribution and frequency of every variable analyzed in form of table, or graphic and narrative while Multivariate Analysis; this analysis means for testing every free variable together to search where is the most dominant (*The best Fit Model*) with double logistic regression.

3. Result

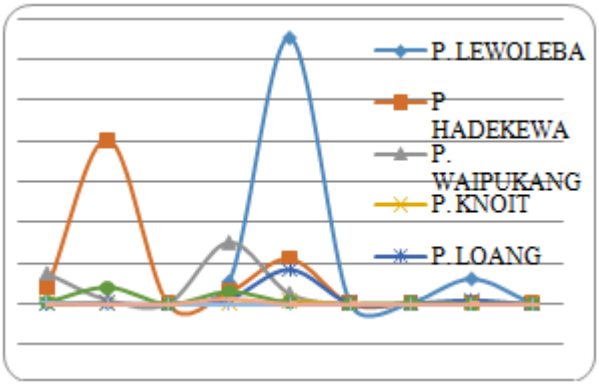
Discovering system of malaria cases by health workers in the level of Health Center for Society is passively using data with triangle conventional indications such as fever, shiver,and sweating generally not yet detecting all patients at all isolated areas in which needed help from health cadres. Basic concept of villages malaria cadres involve staffs, training substance same with Village Malaria Observer called Juru Malaria Desa (JMD), just different in funding. Funding for cadres of village malaria fully handed to society through society self funding (Sahat O, 2005). Health Cadres also were able to being involved in discovering malaria cases but the difficulty is that how to differentiate main indications or other indication more specifically. According to Sri Utamiet.all (2008) validity result of Rapid Diagnostic Test as supporting tools for cadres in discovering malaria cases *P. Falciparum* showed better sensitively for detecting *P.vivax* with results not different from gold formal standard. The output from three *meso-endemic* areas in the District of Purwekerto Rapid Diagnostic Test shows 76,4% sensitively; end 92% specify, means that the tools able to detect plasmodium which can be done by health cadres.

Based on the result of analytical research that related with geographical condition found some dominant geographical condition such as rainfall rate, temperature and dampness, geographical, beaches, hills, rice field, farm, slopping areas, valleys, steppe, savanna, lawns, bushes, lagoon, big trees, and small trees, mountains, dikes, rivers, water sources conservation. However, by (Soedarto, 1996) geographical which common exist in areas with tropical climate which has uncertain rainfall rate, and areas with plenty rice fields or water ponds are potential for plasmodium inhabitants.

Result Investigation Report of Malaria Cases in the Archipelago of East Nusa Tenggara Province is very variable with such effecting aspect of spreading is geographical issues. Geographical in each area has unique character that make the archipelago areas become malaria endemic area. Lembata and Adonara islands are chosen as area of research because those islands have high *annual parasite index* as shown in the table below.

Area of Adonara island that generally detected through *rapid diagnostic test* found most kinds of *plasmodium* is *P.vivax* (Global Fund Aid) that it typical is incidental year 2008-2010, means malaria spreading caused by complex factors such as; influence by local character of area including ecological differential that specifically and become proper inhabitants *anopheles mosquitoes.* For instance, rice field areas, mountains (Ile Boleng), Hills (Seburi), and beach that surround Adonara Island that has different tall and kinds of vegetation. Beside that malaria spreading also caused by other factors such as environment changes, vectors, communities' social changes, medicines resistance, and access for health services.

It can be analyzed that the possible inhabitant for breeding place or resting that become common risk factor in the Health Center for Society with high trending kinds of plasmodium and become indigenous cases. A victim person has possibility to be infected by more than one kind of plasmodium; that infection called mixed infection. The most mixed infection consists of two kinds of mixtures that are *P. Falciparum* and *P. Vivax*. Mixed infection usually happens in area with numbers of high transmission rate. More less 98 % of available blood is positive at the microscopic test that found species *P. Falciparum* and *P. Vivax*. Why? It is because species *P. Malariae* and *P. Ovale* seldom to be found (Susana, 2005).



Diagram; Trending Kind of Plasmodium Based on Center of Health for Societies in Lembata Island, 2006-2008
Data : East Nusa Tenggara Health Department 2010

This diagram shows kinds of plasmodium that spreads in the areas of Lembata island year 2006-2008. The most plasmodium found is *P. Vivax* which available in the Center of Health for Societies in Lewoleba and Hadakewa. Based on trending kinds of plasmodium of Center of Health for Society in Lembata island is variable every year and enough average in all Center of Health for society.

Malaria spreading in Lembata Island can be predicted as an impact of complex factors, such as influence by local characteristics of areas including ecological differentials of the area. Geographically, Lembata Island included as area with tropical climate that divided in some specific ecological areas and become proper inhabitants for anopheles mosquitoes. LembataIsland has valleys and hills, mountains, beaches and mangrove forest or ponds, river mouths that are main inhabitants of anopheles mosquitoes.

4. Discussion

Right now, malaria still becomes a burden of societies and the government of Lembata. As in fact that Lembata is newly district formed and burdened by high disease and mortality of population such infants, under five children, mother, productive ages' group. By this situation, human resources quality and work productivity and tourist (economic impact) decreased. Therefore, effort in preventing malaria become one of development action in Lembata Island and become one target of MDGs (goal number 6 that is preventing HIV/AIDS, malaria and other infectious diseases). Therefore prevention and elimination of malaria is should be done sustainably by all related stakeholders (Indonesia Health Minister Decision 293/2009).

Malaria clinical index development can adjust with program development of vigilant village and the present of Village Post of Health (Poskesdes). It can defined that Vigilant village is a condition of communities or villages which have ability in discover the present issues then make plan design and take action based on resources and always alert to face health issues, disasters and emergency situation.

The development of vigilant village carried out through helping/facilitating people to undertake learning process via cycle or spiral of problem solving that organized (society organized) by undergoing steps. Those steps are (1) indentifying problems, cause of problems, resources are used to overcome problem, (2) diagnose problems and designing alternatives for problem solving, (3) maintain alternative and suitable problem solving, designing and carry out, and (4) observing, evaluate and establish sustainable efforts that carried out.

From this step, geographical index as beginning indication of malaria cases as effort to overcome or prevent malaria disease in a large scope in which useful for cadres in the villages toward self-reliance in preventing their own environment issues. One of action form of Village Post of Health's cadres is self alert survey which called SMD or Self Alert Observation which called TMD or called also *community Self Survey (CSS)* which aim to improve people ability to do community Self Survey for their village. This survey should be done by the principles of local villages with the guidance of health workers. By this, it is hoped that they aware with issues that their village is faced. Including constructing village post for health as effort to proximate basic health services toward villagers (the Republic of Indonesian Health Department, 2009)

From geographical condition, living place of respondents can be achieved from the most dominant variable such as small trees (70,8%), big trees (62,6), lawns (44,6%), steppe (40,4%), bushes (37,6), beaches (35,3%), hills (34,3%), savanna (21,3), rivers (13,6%), valleys (13,1%), slopping areas (10,3%), farms (8,6%), rice field (8,2%) and water source conservation (4,2%) which can be presented on this following table;

According to Armenia, Keshishjan A, malaria has been inhabited in Armenia since ancient times because of the supporting environment and climate, the disease spread out around the country. As an output of an effective campaign to prevent malaria, malaria had been eliminated in Armenia last 1998, 1156 cases reported, 542 from which are results of local transmission. Support from WHO in year 2001 involve available funding used for presenting seminars for *paracitologyst*, entomologist and medical clinic activist. In *Belarus* and *V. Kluchenovich*, because of the climate and geographical condition, this country counted as country with low risk of malaria transmission. Study of entomology has been shown the four available species of anopheles in this country, particularly *An.macullipenis, An. messae, An. clavigerand An. atroparvus*. Other than that is that population density that highly enough as an impact of many available larva inhabitants and as an impact of geographical condition that contribute to the multiplying of mosquitoes. As results of big number of migrants to that country reported that malaria cases often increase with lots of risk every year.

From results of geographic condition respondent it can be said that dominant inhabitant is environment that proliferated by trees, big trees, small trees, lawns, steppe, bushes, beaches, hills and valleys, savanna, slopping areas, farms, and rice fields that generally indicate breeding place or resting of transmitter vectors of malaria cases. Diseases case based on the environment. The existence of disease indication at communities or population is a result of interaction between human with the environment that has

potencies for the present of dangerous diseases (Ahmadi, 2011). Human in this case should be seen from physical, socio cultural or genomic status perspective. Whereas, environment with dangerous potencies of diseases in the component of environment contain one or more disease agents, such as; microorganism group, chemical compound, toxins or energy that radiated. The impact of this disease agent toward human in a knot theory will cause functional deviation that known as series of indications (Achmadi, U.F, 2011). Geographical condition is the main challenge and isolated areas caused limited access for health services, poverty, farming area and lush forest (Aris S. 2011). This indication seen at research's results that people who are living in East Nusa Tenggara Province Archipelago effects the multiplying of vectors that become

The situation of disease agent at transmission media is from a place that we are ordinarily mentioned. The condition of disease source is environment, trees, lawns, valleys, sloping areas, steppe, savanna, become better media for the source of disease. Disease surface or the dynamic of environment is very complex and need for time and possible for changes, before finally meet population at risk groups.

Human interaction with kinds component of environment in any area influenced by global determinant changes such as; global warming and varieties or complexity global trade that it typical depend on behavior or behavioral exposure concept (Achmadi, 2011). In the archipelago of East Nusa Tenggara the most dominant is P. Vivax that spread almost in all Center of Health for Society. Malaria is spreading in the archipelago is predicted as an effect of complex factor and influenced by local character of areas, including ecological differences. For this, it is need to put attention on large factors that stimulate health issues or unaccomplished basic issues such as malaria cases that happened in islands that determined by three factors such as; social and economic inequality, social based and environment condition (Dachlan, YP 2010).

Three big components that become trigger for the endurance of disease at a certain geographical condition is poverty as an impact of social and economic disparity whether economically or institutionally. Economic poverty will bound people from access of health properly and fast. However, institutional poverty let it be and nurturing the disease as an interest issue for social disparity epidemic (Dachlan YP, 2010). This issue also found by Walton DA et.all, 2004 about the irony of 21 century inside the medical doctors' world in which morbidity persistence of infectious disease, only language that is used as structural barrier and as any indicator for main structural challenges in preventing malaria with variant geographic condition. In this situation, it is happened some kind of permitting for the improvement of disease that risked toward human mortality especially for productive ages.

The extended of health services toward society cross-islands find difficulties as far as spreading of islands that take distance each other. Geographical condition because of mountains, hills, valleys is remote area in the border. East Nusa Tenggara consists of 1.192 big and islands. Number of occupied Islands is 473 whereas islands without name are 719 in which East Nusa Tenggara is called as an Archipelago province. Eventhough separated ocean causes difficulty during rainy season and strong wind. In this situation, it is difficult to distribute logistics to all areas such as to Flores Island, Sumba or Alor how much more to small islands. The risk from storm or rain is that immunization cannot be done for direction, extraordinary infected results is difficult to be handled how much more all activities of health services totally stopped. Usually come up many difficulties during rainy season start from November until March.

Malaria case become a serious concern in health services such as helping target patients The result of regression logistic test for geographic index

	Model Log Likelihood	Change in -2 Log Likelihood	df	Sig. of the Change
Beach	-266,608	10,847	1	,001
Farm	-264,816	7,263	1	,007
Hillside	-264,163	5,957	1	,015
Savanna	-262,693	3,017	1	,082
Lawn	-263,617	4,865	1	,027
Big Tree	-262,894	3,419	1	,064
Small Tree	-267,156	11,943	1	,001
Dike	-265,822	9,276	1	,002
Pond	-267,153	11,937	1	,001
Puddle	-268,037	13,705	1	,000

Based on the result of regression logistic test shows that variable with risk to improve cases through locus of main vectors is puddle or lagoon, dike, small tree, farm, and beach with cumulative experience to improve malaria case in archipelago. Small Island areas have much of this characteristic as a good media for descend and main vectors. If small islands have this variable we can predict possibility of huge cases of malaria on children or old ones or almost all ages infected by malaria.

5. Conclusion

Many people will become victims of malaria if inside those small islands have main base for vectors such as; puddle or lagoon, dike, small trees, farm and beach who are victims of malaria in remote areas because possibility of not receive maximal service for health because of difficulty in distributing *Rapid Diagnostic Test*. Moreover, verification toward plasmodium inside blood through microscope not available in village centers of health in which cause the spreading of malaria at remote areas. By time of undergoing blood test, it can directly identify person who are victims of malaria. It is very ironic if we use *Annual Parasite Incidence Indicator (API)* with many victims but cannot be reported because of have not yet undergoing blood test. It is proved by the time the team made blood test in some small and remote Center of Health for Society.

6. Recommendation

People participation is urgently needed to prevent malaria and this index as the first guideline for society in small islands in which it can be done further surveys or treatment.

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