ANNEX I

APPLICATION OF GEOGRAPHIC INFORMATION SYSTEM (GIS) IN MONITORING AND EVLUATING FACTORS AFFECTING MALARIA TRANSMISSION IN THE PHILIPPINES

Proponent Agency: Malaria Study Group, Research Institute for Tropical Medicine. Dept of Health, Manila, Filinvest, Alabang, Muntinlupa City 1781, The Philippines

I. BACKGROUND AND SIGNIFICANCE

Despite decades of control efforts, malaria remains a major vector-borne disease the Philippines. Eleven million Filipinos are residing in 9,345 barangays (villages) distributed in 760 municipalities in 60 provinces are at risk of this disease. Endemic areas are characterized by inaccessibility, inadequate or poor quality of health services in addition to breeding sites for the principal incriminated mosquito vector *Anopheles flavirostris*. Until the turn of the century, *Plasmodium falciparum,* which can cause the more severe form of the disease was the predominant parasite species and contributed to 70% of the total reported cases. In the past year, a shift to *P. vivax* as the dominant species has been observed in areas in Mindanao Island.

Studies conducted by the Research Institute for Tropical Medicine have revealed that there exist pockets of relatively higher malaria transmission in known endemic areas. It is known that focal distribution of the disease is largely affected by several determinants – environmental and geographic, population migration, behavioural, health care delivery system, cultural and socio-economic status of the population. This situation calls for different approaches and flexibility in applying interventions to achieve maximum benefits from the limited resources.

An important consideration in planning malaria control intervention is accurate epidemiological assessment of the area. Malaria data is collected in different tiers of health services all over the country. Its quality is sometimes poor and unreliable. Additionally, systematic methods of analysing data, monitoring and evaluating effectiveness of disease control are often lacking even at the national level and within regions, provinces and municipalities. Detecting and responding early to outbreak situations and preventing their occurrence are major challenges.

One possible solution to monitoring the changing malaria epidemiology pattern and predicting outbreaks is a reliable surveillance tool with predictive capacity. This study proposes the use of geographic information system (GIS), for malaria monitoring and surveillance, to identify spatial and epidemiological patterns of the disease that include malaria cases, vector distribution and behaviour, topography, population mobility and access to health service infrastructures, therapeutic response patterns and other factors.

II. OBJECTIVES

1. To develop RITM institutional capabilities and capacity for malaria GIS constructed with the following epidemiological and climatic parameters: serology, parasite strains, therapeutic response to antimalarials, rainfall, vector studies (e.g. habitats) and bioassays, and population mobility;
2. To enable the model to perform as a dynamic data reservoir concerning the malaria (and other vector-borne diseases) situation in the country and factors affecting its transmission;

3. To make this information of use to malaria control policy and implementation of control strategies;
4. To make this information available to the general public through the RITM webpage including downloading and uploading capacity; and
5. To develop Institutional capacity for training and technology transfer.

III. METHODOLOGY

1. Duration: Two phases over three years

2. Study Sites

For the first phase of the project, the sites will be those from past RITM project sites: Morong, Bataan, Esperanza, Agusan del Sur, and El Nido, Palawan. All possible data from these study sites will be compiled (epidemiological and serological, cases by species, therapeutic efficacy surveillance, ecological and climatic data, parasite strains from past and current studies, vector studies, bednet bioassay, etc.). Additional or new data that need to be collected will be identified and be interlaced with other information. The study sites will be mapped using aerial photographs. Generated maps will be digitized to plot roads, streams land use patterns, vegetation and location of houses. Data on malaria incidence (demographic, occupation, housing structure etc.) will be entered. Through the use of new statistical and spatial modelling procedures, the final product of the interaction is hoped to give a comprehensive picture of the dynamics of malaria transmission in the areas, with expected capacity to forecast epidemics/outbreaks and choose appropriate control (disease and vector) intervention in endemic localities.

The next phase would be wider in coverage to start a province wide (nationwide if possible) GIS of malaria and malaria control in the Philippines. This study will compile and describe malaria transmission over time and identify environmental factors affecting transmission. Collaborations with the following agencies/offices shall be sought: DOH offices including the National Malaria Control Program (MCP), National Epidemiology Center (NEC), Philippine Atmospheric Geophysical and Astronomical Services Administration (PAG-ASA), National Statistics Office (NSO), Land Use and Planning Division of Department of Environment and Natural Resources (DENR) and Department of Agriculture (DA), and Department of Interior and Local Government (DILG)

3. Project Design

This proposal is a combination of cross-sectional, retrospective and prospective analytical studies.

4. Data Collection Techniques and Tools:

The specific data collection techniques and tools will be described in the context of the different component activities of the project:

a. Epidemiological review of malaria cases

This will be a retrospective analysis on the epidemiology of malaria in the country over the past 10-20 years, depending on the availability and reliability of data from the regions/provinces to be able to pin down the localities where there was/is transmission. The number of cases will serve as a substitute measure of the intensity. Malaria data from 1985 to the present from each municipality ("barangay" or village/hamlet level, if possible) of the six provinces will be collected.

b. GIS mapping of localities where there was/is malaria transmission in the years

Data on the following variables will be collected through remote sensing for each locality:

a. Location and type of roads, trails and others
b. Location and type of health facilities
c. Location of potential breeding sites (type of water body and amount of vegetation)
d. Location and population density (demographic and socio-economic indicators may also be incorporated)
e. Location and clustering (if any) of malaria cases (from passive or active case detection)

c. Entomological evaluation in areas where malaria transmission occurred in 1980, 1990, 1995 but none in the past three years

To determine the malariogenic or epidemic potential of these areas

d. Serological surveys in different ecotypes in selected areas where there is ongoing transmission in the past three years

e. Therapeutic efficacy
   a. In vivo studies
   b. Molecular epidemiology (Genotyping of drug-resistance markers)

5. Plan for Data Management and Analysis:

A database for all the data collected will be developed and entered into digitised maps as attributes for each locality/village. Assuming that this project is successful in

validating the usefulness of serological surveys in schoolchildren, a GIS-based malaria surveillance system will be developed and pilot-tested in selected areas (province?) where there are ongoing community-based interventions.

In the selected pilot area(s), quarterly serological data will be also be entered into the database for prospective as well as cross-sectional analysis of malaria transmission. The system to be developed should also be able to monitor and evaluate the effects of the interventions being implemented.

Serological data will be stored in a database (Excel)

6. Proposed Budget for Year 1

Item	Amount	Unit	TOTAL	
			Php	US$
Personnel				
Data manager and programmer	25,000.00	13	325,000.00	5,909.09
Assistant	18,000.00	13	234,000.00	4,254.55
Honoraria	150,000.00		150,000.00	2,727.27
Supplies (see attached list)			100,000.00	1,818.18
				-
Equipment				-
(1) desktop computer with GIS software		1	150,000.00	2,727.27
(1) laser printer with scanner		1	20,000.00	363.64
Travel				
Airfare				
3 persons x 4 trips	9,000.00		108,000.00	1,963.64
Per diems (including hotel accommodations)				-
3 persons x 10 days x 4 trips	1,500.00		180,000.00	3,272.73
Local Travel/Fuel (4 trips)	6,000.00	4	24,000.00	436.36
Others				
Communications/Sundries	3000.00	12	36,000.00	654.55
TOTAL			1,002,000.00	18,218.18
Administrative Cost (10%)			100,200.00	1,821.82
GRAND TOTAL			**1,102,200.00**	**20,040.00**

Annual Report for April 2005-February 2006

Project title: Establish new monitoring tools of malaria

Principle Investigator:
Jetsumon (Sattabongkot) Prachumsri, PhD.
1. Chief, Laboratory Science Section, Department of Entomology, USA Medical Component, Armed Forces Research Institute of Medical Science, Bangkok, Thailand.
2. Adjunct Professor, Biology Department, Faculty of Sciences, Burapha University, Chonburi, Thailand
3. Adjunct Staff, Pathobiology Department, Faculty of Sciences, Mahidol University, Bangkok, Thailand

Research activities:

In Thailand *Plasmodium falciparum* and *P. vivax* are highly prevalent in many malaria endemic areas, whereas *P. malariae* and *P. ovale* have been found only in a small proportion of cases. For 4 years we have studied malaria transmission in a village in western Thailand where malaria is hyperendemic. The majority of parasite carriers show no symptoms with low parasitaemia all year round, which suggests that these individuals have naturally acquired protective immunity. We propose to identify the correlate(s) of protective immunity to *P. falciparum* and *P. vivax* in this population. Blood will be collected by venipuncture from people with malaria positive or negative blood smears. Serum and peripheral blood mononuclear cells (PBMC) will be separated for each sample. Humoral immunity to sporozoite, blood and liver stages of *P. falciparum* and *P. vivax* will be characterized to identify parasite epitope(s) which will be a vaccine candidate(s) that is (are) able to enhance human protective immunity. This approach will also give us a chance to find out new parasite antigens for the diagnostics and/or epidemiological surveillance.

The Specific Aims:

1. To identify protective immune response in population with symptom and non-symptom by characterize humoral immunity to *P. falciparum* and *P. vivax* parasite using parasite crude extracts and recombinant proteins of both known malaria vaccine candidates and novel candidates.

2. To identify parasite antigen(s) that activates humoral immune response to blood, liver and sporozoite stage parasites.

Progress for period of April 2005-February 2006

Sample collection:

1. Blood samples were collected from 102 villagers live in Kong Mong Tha, a malaria endemic village in Kanchanburi, who had blood smear positive for either *Plasmodium falciparum* or *P. vivax.* Plasma and blood cells from each donor were separated and frozen in dryice before being transported to laboratories in Bangkok for further experiments. An aliquot of infected blood was fed to *An. dirus* mosquitoes to study the parasite infectivity and host immunity.

2. To prepare malaria blood stage antigens for IFA assay, the parasites were prepared from malaria infected blood collected from patients who came to malaria clinic in Maesod district, Tak province. Sporozoite antigens were prepared from mosquitoes fed on malaria infected blood. During this period there is no antigen preparation for liver stage parasites.

3. Standard membrane feeding assay was performed to access natural transmission-blocking immunity by using plasma collected from villagers in Kong Mong Tha mixed with malaria infected blood and fed to *An. dirus* mosquitoes.

Results:

1. Plasma collected from 3 of 70 villagers from Kong Mong Tha who had *P. vivax* positive blood smear show transmission blocking immunity against P. vivax parasites collected from each donor and malaria patients in Maesod.

2. Plasma collected from 3 of 32 villagers from Kong Mong Tha who had *P. falciparum* positive blood smear show transmission blocking immunity against *P. falciparum* parasites collected from each donor and malaria patients in Maesod.

3. In summary, naturally acquired transmission blocking immunity to *P. falciparum* and *P. vivax* occur in an endemic population in western Thailand.

Future Plan:

1. Plasma that showed transmission blocking efficacy was sent to Dr. Takafumi Tsuboi laboratory for screening of malaria antigens that will be reacted to these plasma. The antigens that will react with the collected plasma may be used as candidate for future vaccines or developing of diagnosis for surveillance of malaria transmission.

2. There will be more samples collected in the following year

3. Liver stage antigens will be prepared and used for screening of pre-erythrocytic stage antigens that will be recognized by naturally acquired immunity.

Ministry of Health
National Centre for Parasitology,
Entomology and Malaria Control
(CNM)

Kingdom of Cambodia
Nation Religion King

Epidemiology and Control of Malaria in a Newly Developed Region in Kampot Province, Southern Cambodia.

Report Activities

Period: October 2005 to February 2006

Date: 25th December 2006

Dr. Duong Socheat
Dr. Muth Sinuon

Supported By

Ministry of Health, Welfare and Labor of Japan (A grant on "Research for emerging and re-emerging infections"

Introduction

Cambodia has a population of 13.1 million. 62% of land mass is covered by sparsely populated, forest and jungle where Anopheles dirus and minimus as the principle vector mosquito. There are four main categories of people affected: ethnic minority groups, forest fringe inhabitants, temporary migrants and new forest settlers where are epidemic prone due to the settlements of non-immune adult populations and absence of any kind of health system even private in the settlement areas.

At this moment malaria is still a major health problem affecting morbidity, mortality and decreasing socio-economic in Cambodia even many malaria cases and deaths were decreased during the past few years. Due to rapid population growth and economic demand, a number of people migrate to forested area and engage in deforestation and agriculture. Increasing human contacts with vector mosquitoes and the lack of access to health care have caused malaria epidemics in forest fringe areas. Therefore this project aims to establish an effective malaria control and monitoring system in a newly developed region.

The project has selected 5 villages in Stung Keo commune as a pilot study where is located in a malaria endemic area, malaria epidemiology has not been studied yet. Because the nearest health center (Kampot Health Center) is as far as 40km away from the commune, it is extremely difficult for the residents to go to the health center, especially in the rainy season.

Objectives

1) Collect accurate data on malaria incidence and prevalence in the commune by baseline survey
2) Monitor the changes in malaria incidence in a long run so it will be possible to predict malaria outbreak in the near future
3) Provide accurate diagnosis and treatment according to the national guideline to control malaria and to prevent drug resistance
4) Improve knowledge and skills of residents to prevent from malaria

Material and Method:

This project was conducted by utilizing the network of the central and local governments.

We have selected five villages in Stung Keo commune, Kampot district, Kampot province, where the land was covered with a dense forest until nowadays. They started cutting down the forest and creating agricultural land to cultivate rice, vegetables and fruits.

In order to prevent malaria epidemics in the region, in October 2005 the project team went to conduct the meeting with the Provincial Health Department (PHD) director and Provincial Malaria Supervisor to provide the purpose of this project and make agreement in collaboration for implement of the project.

Based on discussion within the meeting, the potential project malaria worker (PMW) supervisors were identified. They are the provincial, Operational District (OD) and Health Centre (HCs) malaria supervisors. Then we went to visit each of the villages where were identified during the first phase.

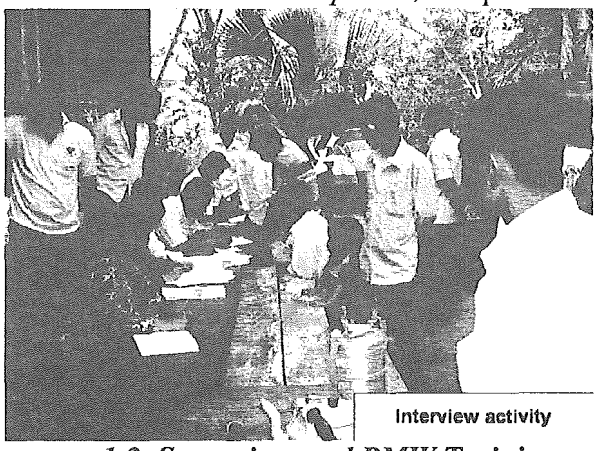
Two PMW were recruited in each village who that pointed by chief of the villages and the chief of health centres. The candidates were selected on the basis of literacy availability, well-known in their community and live in an accessible location.

1. Baseline Survey.

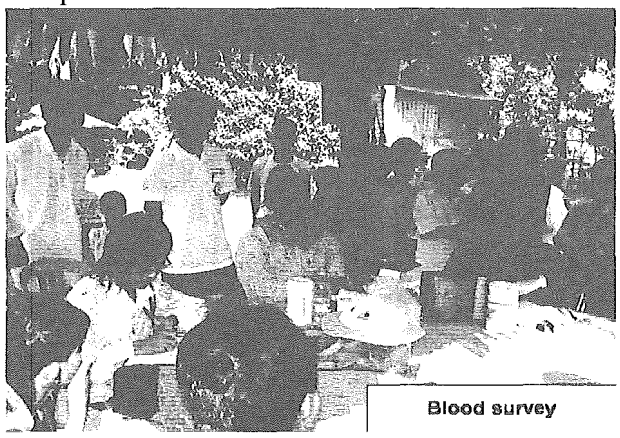
1.1. Interview and blood taking at household.

Based on environmental and demographic aspect, households were selected for the survey in the 5 pilot villages only the family just come to live in those villages in recent year and the family who stay less than 200 m from forest. A questionnaire was administered in each selected household. The person interviewed was the head female where possible.

A finger prick blood sample was taken from a select sample of four individuals in the household, one from each of the following groups: one aged 0 to 4 years, one aged 5-14 years, one adult female and one adult male (except where not all occur) and finger prick samples for RDTs were taken from the persons who get the fever in that time. The RDT used was Paracheck F ®, which detects *Plasmodium Falciparum,* and persons with a positive RDT were treated.



Interview activity



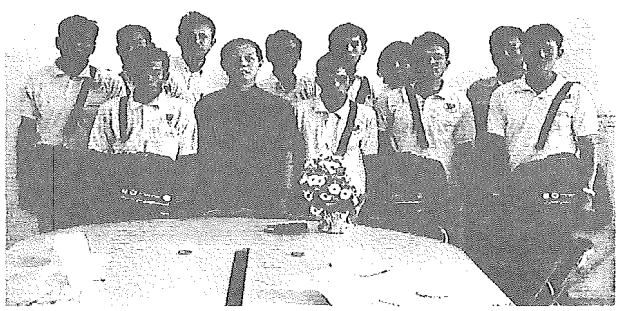
Blood survey

1.2. Supervisor and PMW Training

Candidates for the position of supervisor underwent one weeks' on-the-job training, alongside a more experienced worker (provincial malaria supervisor and/or CNM staff).

Training curriculum and monitoring form for the PMWs and the supervisors developed and reviewed before the implementation of training.

The contents of the PMW training curriculum included the pre and post test (15 questions), cause of malaria, signs and symptoms, performing rapid diagnostic tests (paracheck), interpreting the RDT results, dosages of anti-malarial per age group. Record keeping of the RDT tested, results and treatment provided. Dangers signs of malaria and referral of RDT negative fever cases. Note the migration of population, construction of new house, land transformation and residents' behavior change. At the end of the training each VMW was given a special kit that included dipstick tests, lancets, alcohol, dissolvent, A+M pre-packaged boxes for the routine work in their own villages.



1.3. Monitoring and supervision of VMW activities

The supervisor has to make the link between the PMW and the provincial malaria supervisor once the network is established.
Planned to organize regular monitoring of PMWs. The CNM, PHD, OD and HC staff to take part on the monitoring process.

At the beginning of the project implement the HC and OD staffs have attended the weekly PMW meetings to check and collect malaria information data and to refill the PMW kits. It has been planned that the CNM staff will organize regular visits to monitor the VMW activities. The visits will be meeting places and the villages to observe directly the PMWs activities and to provide necessary guidance. The supervisor visits from CNM were biweekly in the first months after training, and a monthly when everything was considered to be running smoothly.

Results

1. Baseline Survey.

175 family came to live in 5 pilot villages study in the recent years were selected to interview and do malaria blood slides to know the real situation and the malaria prevalence and incidence.

The number of the household selected in each pilot study villages, Stung Keo commune / Kampot province in December 2005.

No	Name of Village	Total family	Total population	Selected family	Selected population
1	Dong	135	662	19	76
2	Mlech Koul	112	591	21	72
3	Anlong Mac Prang	213	1056	30	102
4	Trapang Kok	142	734	47	164
5	Dom Rei Phong	286	1455	63	241
	Total	**888**	**4498**	**180**	**655**

The result of questionnaire related to knowledge of Malaria in pilot study.

Village	Sign/ Symptom %	Treatment public health %	Private Sector %	Use bed net %	use impregnated bed net %	Exposed working in forest %
Dong	70.3	28.7	68.2	64.2	35.7	7.5
Mlech Koul	74.7	33.6	61.6	49.4	47.1	13.3
Anlong MacPrang	87.1	41.9	59.0	54.2	24.0	8.4
Trapang Kok	69.0	27	67.5	48.6	47	9.7
Dom Rei Phong	57.9	31.3	62.2	43.6	51.2	14.6
Total	**71.8**	**32.5**	**63.7**	**52**	**41**	**10.7**

The result of Malaria incidence during conducting the survey using Rapid Diagnosis Test (RDT) in December 2005

No	Name of Village	No of patient with fever	No. RDT (Paracheck) positive with PF
1	Dong	12	4 (33.3%)
2	Mlech Koul	5	2 (40%)
3	Anlong Mac Prang	12	4 (33.3%)
4	Trapang Kok	27	10 (37.0%)
5	Dom Rei Phong	6	1 (16.6%)
Total		**62**	**21 (33.8%)**

The result of Malaria prevalence by blood smears in December 2005

No	Name of Village	No of slides	No of slide positive	P. falciparum	P. Vivax	Mixte (Pf + Pv)
1	Dong	76	9 (12.5%)	7 (9.2%)	2 (2.6%)	0
2	Mlech Koul	72	3 (4.2%)	2 (2.8%)	1 (1.4)	0
3	Anlong Mac Prang	102	6 (5.9%)	4 (3.9%)	1 (0.9%)	1 (0.9%)
4	Trapang Kok	164	12 (7.3%)	11 (6.7%)	0	1 (0.6%)
5	Dom Rei Phong	241	8 (3.3%)	6 (2.5%)	2 (0.8%)	0
Total		**655**	**38 (5.8%)**	**30 (4.9%)**	**6 (0.9%)**	**2 (0.3%)**

2. Training results

The trainers were from the CNM and the PHD and OD supervisors. To keep the involved the HC staff in the training process, they participated as the assistant trainers.

The total of 10 Malaria Workers in 5 project villages followed 3 days training organised at Provincial Health Department. In all training sessions the pre and post test conducted to assess the effectiveness of the training. Most of the training sessions conducted are on the practical aspects of RDT testing, dosages of anti-malarial drugs, administration of drugs and filling up the forms. The participants went to the real practice in the village for clearly understanding.

3. Monitoring and supervision of VMW activities

The PMWs attend the monthly meeting with the project team from National and provincial level at the nearby HC location. The VMW data record sheets are checked routinely comparing with RDT test results in the test devices and recorded results. The dosages per age group also being checked. The migration record sheets also verify.

Data collected on routine work of PMW during 3 months from December 2005 to February 2006 in 5 project villages.

Total house hold	Total pop.	House hold increase	Pop increase	Land transform ation	The patients with fever	RDT tested	RDT Positive	Patient treated with A + M	Refer to HCs
888	4498	14	51	300 hectare	238	146	60	60	10

From January to March 60 positive cases reported in the 5 villages, which gives the malaria prevalence of 41% among patient with fever and suspect malaria cases.

Discussions

The regular monitoring and supervision is a very essential part of the successful implementation of the village based early diagnosis and treatment. Since the PMW are the simple villagers without medical background trained for 3 days on diagnosis and treatment would needs quite regular support from the supervisors.

From the project study we understood that if delegate some responsibilities to the provincial staff like conducting routine monthly meeting and data collection, thus the central level staff will have more time to visit villages on regular basis to monitor the PMW activities.

Conclusions and Recommendations

The PMW team would benefit from training on proper data compilation, analysis and presentation of the Key results. This was identified by the team as an area in need of more sustained attention.

Health Education should be provided to the Community for malaria without delay for diagnosis and Treatment.
Regular monitoring the PMW should be the priority activity to make the project successful.

This project fits in perfectly with the underlying principles of any primary health care programme, as residents play an active role in the health decision-making process and gain increased awareness of the roots of health-related problems and the ways to treat them. Local communities acquire a sense of responsibility and commitment to health activities, and in the end, contribute to the sustainability of the project.

Acknowledgment.

I would like to express my thanks to all the members of the study project at National levels and provincial levels especially project malaria worker for their effort to obtain high quality information to improve to improve the malaria control programme and monitoring the malaria Epidemiology in a Newly Developed Region in Kampot Province, Southern Cambodia under support of the Ministry of Health, Welfare and Labor of Japan (A grant on "Research for emerging and re-emerging infections"

We would like to thank the General National Institute of Infectious Disease ,Japan for the generous support, they have provided to the National Centre for Parasitology, Entomology and malaria Control in Cambodia.

Finally we acknowledge with great appreciation the householders, who give up their time to provide our interviewers with information.

CNM, 28 February 2006

Seen and Approved
CNM Director

Dr. Duong Socheath

Reported by

Dr. Muth Sinuon

Strengthening Malaria Surveillance System In Central Java Province Phase I, Baseline study.

Wibisono H, Laihad F, Herawati L, Munanto A, Tobing C, Junaidi, Warsito U, Widyaningsih W.

Vector Borne Diseases Control Ministry of Health Indonesia, Central Java Provincial Health Office, Wonosobo District Health Office, Pekalongan District Health Office.

ABSTRACT

Malaria is still a huge public health issue in Indonesia. In Central Java, the incidence on malaria declines every year. The API In 2002, API (Annual Parasite Incidence) is 1.44 ‰, decreases to 0.51‰ in 2003 and 0.07 ‰ in 2005. Within Central Java, API of Wonosobo District is still the highest, which is 0.62 ‰ in 2005. However, in this region have ecological conditions that support to increase the number of breeding places potentially. Epidemiologically, surveillance system should be strengthened to monitor case detection early and to ensure response activities. Surveillance system also requires collaboration with the community to detect malaria case at village level.

The purpose of this study is to establish an adequate surveillance system from village level that requires collaboration with the community. This Study uses *quasi experimental* study design with case and control groups. As baseline study, qualitative research method is applied to collect data and information regarding surveillance system and malaria condition from village level until district level.

There are two main groups assessed. The first group is health workers who

in charge in malaria case detection and malaria surveillance. The second group is Village Malaria Agents (VMA). VMAs are community member that have been trained by health workers for detecting malaria case at village level and case investigation.

VMAs and malaria cadres have important rule in community based-malaria detection. They can detect malaria incidence among the community and treat the patients immediately. Health Center can supervise VMAs and malaria cadres and also collects and analyze data from VMAs. District Health Office can measure the impact of malaria surveillance among the community. District also can support the community with technical assistants and arrange some budget from local government. Phase 2 would assess community base surveillance system and facilitate District level to develop a proper surveillance system.

INTRODUCTION

Malaria is a world wide public health problem, mainly in Africa and South East Asia. In Indonesia, Malaria is third leading cause of death in the Eastern Provinces of Indonesia. It is estimated that 15 millions clinical cases occur yearly resulting in 23,483 deaths (National Health Household Survey 2001)

Malaria Control Program has been implemented in Java and Bali Region with fully laboratory confirmation. All malaria patients is diagnosed by microscopy examination and treated with prompt anti malarial drugs. As a result, morbidity and mortality in Central Java has decrease significantly. In 2002, API (Annual Parasite Incidence) is 1.44 ‰, decreases to 0.51‰ in 2003 and 0.07 ‰ in 2005.

Similarly, Wonosobo and Pekalongan Districts indicate that API for both districts decrease every year. It can be seen in table. 1.

Tabel 1. Malaria condition in Central Java, Wonosobo and Pekalongan Districts.

Province/District	Population	No of HC	No of Village	HCI Village 2005	API 2000	API 2001	API 2002	API 2003	API 2004	API 2005
Central Java (Province)	33,569,012	532	8496	109	1.74	1.46	1.44	0.51	0.15	0.07
Wonosobo (Case)	751,416	9	95	13	5.16	3.9	4.7	4.4	1.38	0.62
Pekalongan (Control)	798,605	8	102	1	1.35	1.12	0.66	0.68	0.44	0.06

Although, in other part within this region also have ecological conditions that support to increase the number of breeding places potentially. Some villages are indicated as high incidence on malaria (Wonosobo has 13 villages and Pekalongan has 1 village).

As mortality and morbidity due to malaria have been decreased, case detection in public hospitals and clinics becomes limited to monitor epidemiology and surveillance information on malaria. In addition to passive case detection, active case detection in sentinel site will also be essential. Epidemiologically, surveillance system should be strengthened to monitor case detection early and to ensure response activities. Surveillance system also requires collaboration with the community to detect malaria case at village level.

Purpose and objectives:

The recent progress of malaria control in Java – Bali Region shows that the morbidity due to *Plasmodium* infection has dramatically decreased especially in Central Java Province. This change in epidemiology has resulted in inadequacy of the indicators and systems that had been used for many years.

The purpose of this study is to establish an adequate surveillance system from village level that requires collaboration with Village Malaria Volunteers/Village Malaria Surveillance Agent until district/provincial level.

The objectives for this study are:

- To establish surveillance and early warning outbreak system.
- To monitor malaria incidence and malaria risk factors.
- To explore proper indicators could detect changing malaria epidemiology.

The benefits of this research for Malaria Control Program are:

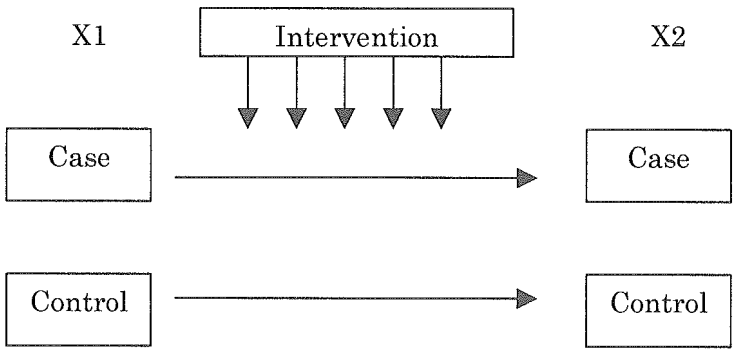
- To develop collaboration with the community to detect malaria cases at village level
- To develop broader functions of Village Malaria Agents
- To conduct need assessment for Malaria surveillance system
- To support elimination of malaria incidence in certain areas in Indonesia

METHODOLOGY

Study design:

This Study uses *quasi experimental* study design with case and control groups.

The study design can be described as follows:



Case Groups are village malaria volunteer/malaria surveillance agents and health workers in Wonosobo District. There are several intervention activities that will be conducted in these groups. Intervention activities are training, on the job training, monitoring and evaluation activities.

Control Groups are malaria village volunteer and health workers in Pekalongan District. No interventions activities conducted in these groups