CHAPTER II

Essay

Community malaria profile : An approach to meet information needs for improved malaria control in Nepal

2.1. Introduction :

A community malaria profile could be a tool for planners and administrators of malaria control programs to select appropriate interventions for improved malaria control. Since it is the collection of relevant information about all aspects of malaria epidemiology of a malarious area, it could help to understand the malaria situation of that area. Based upon which intervention according to the prevailing situation could be devised, control of malaria could be enhanced.

An ideal community malaria profile contains adequate information on epidemiological, entomological, socio-economic, cultural and behavioral factors. That information is about the host (human), disease (malaria), vector (mosquito), environment (physical and climatic) and control activities (by community and health services) according to an epidemiological model of disease transmission and, so, its

control (WHO, 1997). In order to select effective malaria control measures the important roles of those types of information have been well recognized (Gilles and Warrell, 1993). So, planners should have a complete information profile of all aspects of malaria epidemiology of each malaria prone area

In the Malaria Control Program of Nepal there is an epidemiological and entomological profile of malaria. But it only provides information on disease, vector, and environment. For example, it contains the types of vectors and parasite responsible for malaria infection, and epidemiological indices like annual parasite incidence, annual blood examination rate, slide positivity rate up to each malaria prone area and health post level (Dept. of Health Services, 1996; Joint HMG/WHO/USAID Assessment Team, 1994). But it fails to provide information on the host, about their socio-economic and behavioral aspects. Epidemiological information alone is not sufficient to formulate appropriate control measures. Because the distribution and intensity of malaria vary from one place to other and among various factors one of the important factor responsible to make the differences in distribution and intensity as well as for infection are the human behavior and socio-economic aspect of an area (Hongvivatana, 1991; Fungladda, 1991).

It is well recognized that socio-economic factors such as occupations, housing conditions, patterns of migration and labor force movement, deforestation, irrigation, and elements of human behavior such as treatment seeking, personal and

family protection measures against mosquito nuisance, etc. influence malaria transmission and control. A malaria control measures could not be successful if socio-economic and behavioral factors of host in an area are not considered.

At present, the Nepal Malaria Control Program, does not have a community malaria profile on socio-economic and human behavioral aspects in different malarious villages (Joint HMG/WHO/USAID Assessment team, 1994). For this reason, this study aims to design a community profile for the use of central, regional and district level planners and administrators associated with malaria control programs which could facilitate decisions on appropriate control measures to interrupt present transmission patterns. The study will identify the most relevant information that required to be included in the profile and will tell how can those information could be used to decide suitable control measures?

2.2. Community malaria profile :

Ideally, a malaria profile is the collection of information of a given geographical area on vector, host (about their socio-economic and behavioral aspects), disease control activities, physical environment and disease with respect to malaria transmission. This information describes their characteristics and shows their inter-relationships (WHO, 1997) in terms of their contribution in transmission. So, it

is preferred that each problem area should have a separate malaria information profile since the distribution and intensity of malaria vary from place to place.

Complete information contained in the profile will define the malaria situation of an area and provide planners a basis for developing a suitable control program that is appropriate and relevant for that area (WHO, 1997). The information on local conditions will also guide to undertake decision in establishing community participation for intervention of control activities through maximizing the utilization of local resources (WHO, 1997).

2.3. Malaria :

2.3.1. Causes of malaria :

Malaria is a protozoal disease caused by infection with parasites of the genus *Plasmodium* and transmitted to man by bite of certain species of infected female *Anopheline* mosquito. When an *Anopheline* feeds blood meal of a person who has malaria it swallows parasites with blood. If the same *Anopheline* inoculates a healthy person for blood meal, the parasites will be transmitted in that person's blood stream and becomes parasite infected and then becomes ill (Park,1994).

Parasite that causes malaria in man are *Plasmodium vivax*, *Plasmodium falciparum*, *Plasmodium malariae* and *Plasmodium ovale*. *Plasmodium vivax* has

the widest geographic distribution throughout the world and *P. falciparum* is second in distribution. *P. malariae* has a restricted distribution and *P. ovale* is parasite of man, mostly confined to tropical Africa (Park, 1994).

2.3.2. Effects of malaria :

A typical attack of malaria is first characterized by high fever, excessive sweating after few hours of fever and then reduction of temperature. The person suffering from malaria has symptoms of enlargement of the spleen and secondary anaemia (Gilles and Warrell, 1993). Sometimes it is difficult to tell whether a sickness is caused by malaria or some other disease, because the symptoms may be similar. In this situation if the patient's condition has not improved within 2 days after the start of an adequate malaria treatment, he or she needs urgent care in the nearest hospital.

Malaria is dangerous to all but especially in pregnant women and under five years old children. If they get malaria the severity of illness develops rapidly and may even result in death. People living in a malarious area may develop some extent of resistance. But people who come from non-malarious areas to malarious area, if become ill with malaria, the disease may be severe. Some malaria illness are not fatal (if caused by parasite *P. vivax*) but some may be fatal (if caused by parasite *P.*

falciparum) due to cerebral hemorrhage. So, it is essential to contact health workers if a person has fever.

2.3.3. Malaria Mosquitoes :

There are different kinds of mosquitoes. All mosquitoes do not cause malaria but some cause malaria. The mosquito which causes malaria is called malaria mosquito or vector. *Anopheles* is the scientific name of malaria mosquito. Male mosquitoes do not suck up blood, so do not bite and can not cause malaria. Female mosquitoes need blood to produce eggs, so they suck blood and so can transmit malaria.

Female *Anopheline* lay eggs on stagnant or slow flowing water. The eggs are very small and can hardly seen. Malaria mosquitoes breed in collection of water within 2 kilometers of the place where people live. The mosquito larva will come out of each egg 2-3 days after the eggs are laid and lives in water surface. Larva then grows to become pupa after some days and still remains in water. After few days pupa becomes adult mosquito. If it is a female mosquito it may bite people and feed on their blood.

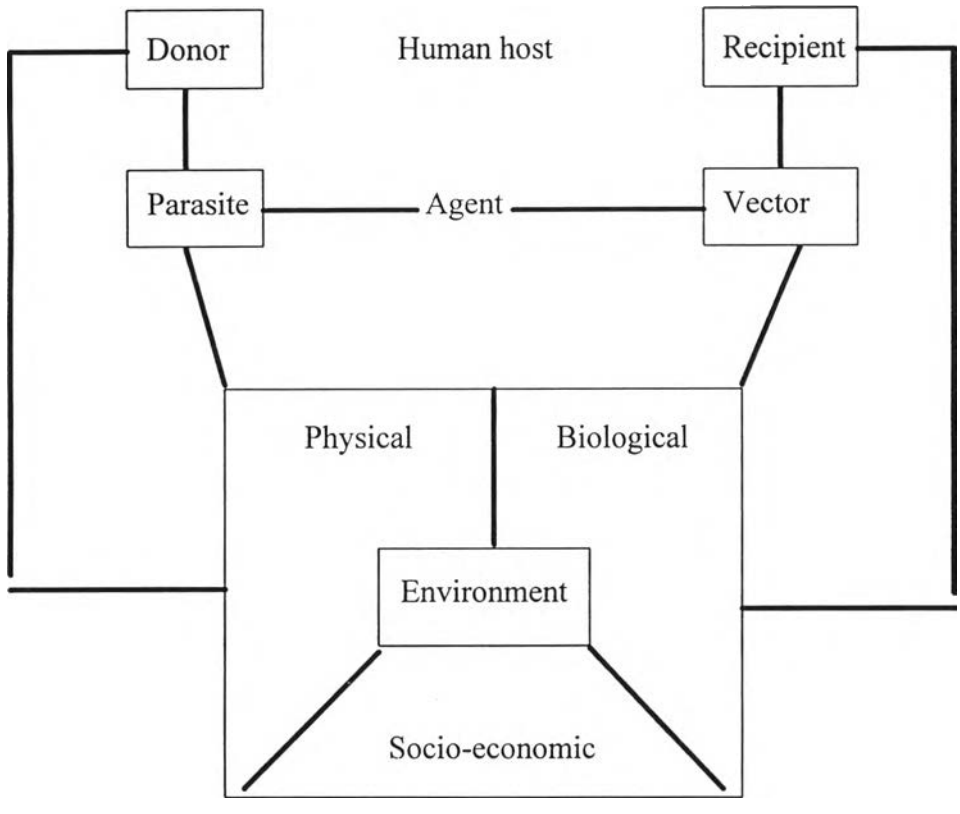
Mosquito usually rests on a nearby surface for a while after feeding and it flies away. It will then lay eggs and the above life cycle repeats again. In tropical climate

it takes about 7-14 days for a mosquito to grow from an egg to an adult mosquito. A new adult mosquito does not have malaria parasites in their bodies unless it bites someone who has malaria.

2.3.4. Transmission of malaria :

Natural transmission of malaria infection occurs through exposures to the bites of infected female *Anopheles* mosquitoes. The natural transmission depends on the presence of and relationship between three basic epidemiological factors; the host, the agent and the environment (Gilles and Warrell, 1993) (Fig. 2.1). Human beings are intermediate host, where malaria parasite undergoes asexual cycle of development which begins when an infected mosquito bites. Mosquito is the definitive host, where parasite undergoes sexual cycle, i.e. proliferation and maturation of parasite to become infective to man. These mosquitoes are called vector and may also be considered as the agent of transmission while parasite is the true agent of the infection. This is represented by the following figure where the environment should be considered from its three aspects physical, biological and socio-economic.

Figure 2.1 : Epidemiological factors of host agent and environment involved in the transmission of malaria.



(Source: Adapted from Bruce-Chwatt's Essential Malariology by Gilles and Warrell, 1993)

The source of human malaria infection is nearly always a human subjects, whether a sick person or a symptomless carrier of the parasite. The alteration between the human and the mosquito host represents the biological cycle of transmission of the malaria parasite. The transmission of the infection by the mosquito from the human carrier (donor) to the human victim (recipient) represents the chain of transmission (Fig. 2.1).

2.3.5. How to prevent and control malaria?

Principles of malaria prevention and control are to protect people from bites of mosquito or curing the person from whom the mosquito gets its infection, i.e. disease prevention and disease management. Disease prevention is always considered as a better way than cure. But complete prevention of the malaria infection in a community can not be achieved. Because all people in a community do not always follow preventive measures and in endemic areas many people do not show symptoms and are not discovered or treated but are transmitting infection. Similarly, it is usually impossible to eliminate all mosquito breeding places in a given geographical area. In this situation disease management through drug treatment becomes essential. However, protection from mosquito bites should always be put into practice and may be expected to yield valuable results.

It is common in practice in all countries where there is malaria epidemic or endemic to formulate common objectives of control aimed at to prevent mortality from malaria and reduce morbidity, endemicity and transmission to a level that it will not hinder socio-economic development. Gilles and Warrell (1993), in this connection, describe different approaches to control malaria and its effects as given below :

Table 2.1 : Principles of comprehensive malaria control.

Type of control	Effect
Individual protection : 1. Mosquito repellents 2. Impregnated mosquito nets 3. Protective clothing 4. House screening 5. House siting 6. Pyrethrum house spraying 7. Antimosquito fumigants	Reduction of human-mosquito contact
Vector control (factors reducing the vectorial capacity) : 1. Environmental modification and manipulation 2. Reduction of vector densities 3. Chemical and biological larvicides 4. Insecticide space spraying 5. Residual insecticide spraying	Reduction of vector breeding habitats Reduction of longevity of vector population
Antiplasmodial measures (factors reducing the parasite reservoir) : 1. Early diagnosis and treatment of acute cases of malaria 2. Chemoprophylaxis and suppression of malaria infection 3. Radical treatment of relapses 4. Mass treatment (epidemics)	Elimination of malaria parasites and prevention of transmission
Social Participation : 1. Health education	Motivation for personal and family protection

(Source : Gilles and Warrell, 1993. Bruce-Chwatt's Essential Malariology)

WHO (1996), in this connection, has also described three main ways to prevent malaria as given below :

(1) Prevent mosquitoes from biting people :

(a) Sleep under mosquito nets (ordinary or insecticide treated).

(b) Screen all windows and doors in the house, or at least in rooms where people sleep.

(c) Apply mosquito repellents to the skin.

(d) Burn mosquito coils.

(2) Control mosquito breeding :

(a) Eliminate places where mosquitoes can lay eggs.

(b) Reclaim land by filling and draining.

(c) Introduce special fishes that eat mosquito larvae.

(d) Put special insecticides in the water to kill mosquito larvae.

(3) Kill adult mosquitoes :

(a) Spray rooms with insecticides before going to bed.

(b) Community participation in activities carrying out by the health services such as spraying the inside walls of houses with insecticides that kill mosquitoes.

Control measures of malaria depend on the local prevailing situation of each country. So, WHO (1993) has advised to all its member countries to adapt control measures according to malariogenic potential and resources available. From the descriptions mentioned above a summarized classification of malaria control measures has been given below :

Table 2.2 : Classification of malaria control measures.

Action	Individual and Family Protection	Community protection
Prevention of human-vector contact	Bed nets, protective clothing, screening of houses, repellents, impregnated bed nets	Site selection, zoo prophylaxis, screening of houses
Destruction of adult malaria mosquitoes	Use of domestic space spraying	Residual indoor insecticides spraying, space-spraying, ultra low volume sprays
Destruction of mosquito larvae	Peri-domestic sanitation, intermittent drying of water containers	Larvicides for water surfaces, intermittent irrigation, sluicing, biological control method.
Source reduction of mosquitoes	Filling, peri-domestic sanitation, small scale drainage and other forms of water management	Environmental sanitation, Water management, drainage schemes, prevention of man-made malaria, naturalistic method of control
Measures against malaria parasites	Early diagnosis and treatment, Chemoprophylaxis	Establishment of diagnosis and treatment facilities, chemoprophylaxis for pregnant women, mass drug treatment (in epidemics)
Social participation	Motivation and personal and family protection	Health education, community involvement, expansion of rural health services, training of staffs

(Source : Gilles and Warrell, 1993. Bruce Chwatt's Essential Malariology)

2.3.6. Interventions (tools) to prevent and control malaria :

A. Protection against the bites of mosquitoes :

(1) Mosquito nets : Use of mosquito net is a way to protect people from mosquito bites during the night time and so as to prevent from malaria. People has been using nets from very early times in order to protect themselves from mosquito and other

insect nuisance and still remains one of the widely used measure among all measures of personal protection. Ordinary nets do not kill mosquitoes but sleeping underneath them protects from mosquito biting.

Nets are usually made by weaving cotton or nylon thread with tiny holes from where mosquitoes can not enter inside. Nets are useful to all but especially to the young children. Because malaria mosquitoes usually bite from sunset to sunrise and young children usually asleep by sunset.

Several field trials have demonstrated that the protective effect of mosquito nets can be greatly enhanced by treating them with special insecticides (Makemba et al., 1995; Marsh et al., 1996; Jambulingam et al., 1989). Because, due to odour of insecticide, mosquitoes either fly away from room or are killed if come into contact with net.

(2) Screening : Screening of doors, windows and openings in the house protect the whole family while a single mosquito net provides protection only for those sleeping under it. So, screening of houses is a way to protect people from mosquito nuisance. Effective screening is possible when house is well constructed and maintained. Various materials (usually metal or plastic) can be used for screening. But the holes of screen should be small enough to resist mosquito entrance through it. Frequent inspection is necessary to detect damage to the screen and to make early repairs. But

it should be noted that people with low socio-economic status may not afford it. Because they can not construct, maintain and screen their house well.

(3) Protective clothing : Thick soaks, long boots, trousers and full sleeved shirts made up of thick clothes and gloves may provide good protection against mosquito biting and especially useful for persons on guard at night. But one should be aware that mosquito may pierce through clothing, which is in contact with the skin. So protective clothing should be thick enough to avoid mosquito piercing.

(4) Repellents : These are chemical substances and is applied to the skin, clothing or mosquito nets to keep mosquitoes away and prevent people from mosquito biting. By its chemical effect mosquitoes do not land on body skin. The effect of repellents of one application lasts from 3-8 hours. These substances are very useful in the evening when people are not under mosquito nets or inside screened houses. The repellent is applied to the neck, wrists and ankles but should not apply to sensitive skin surfaces like eye-lids and mucous membranes. Because it may cause irritation.

(5) Mosquito coils and mat : When mosquito coils burn, their smoke and odour keeps mosquito away. Mosquito do not come within the area to which odour and smokes spread. The coils are not expensive and burn even to 8 hours. They are especially useful early in the evening when people sit outdoors. In market smokeless mat with preferable fragrance are also found. But these are useful in those areas

where electricity facility is available. Mat is kept on a small electric heater. By effect of heat, the chemicals of mat is evaporated slowly leaving mild odour and mosquitoes either fly away or die.

B. Mosquito control :

(1) Source reduction : Control of mosquitoes is one of the method to protect community against the disease. Control of mosquito can be done by source reduction, i.e., elimination of mosquito breeding places through environmental modification and manipulation. The objectives of mosquito control are not to kill malaria mosquito, but to prevent a large proportion of them surviving for 12 or 14 days. The reduction of breeding places can be done up to 2 kilometers of area. Because the mosquitoes that bite usually breed within 2 Km. of where people live.

For source reduction, it is essential to know or have knowledge about the breeding places of mosquitoes. Malaria mosquitoes may breed in (WHO, 1996) :

(a) fresh water or brackish (slightly salty) water, especially if it is stagnant or slow flowing;

(b) open streams with very slow flowing water along their banks;

(c) pools of water left on the riverbed after the rains have ended, or as a result of poor water management;

(d) swamps, rice fields and reservoir;

(e) small ponds, pools, borrow-pits, canals and ditches with stagnant water, in and around villages;

(f) animal hoof prints filled with water;

(g) cisterns (water tanks) for storage of water; and,

(h) anything that may collect water- plant pots, old car tyres etc.

Once having the knowledge about breeding places individual, community and health service can attempt a joint efforts to reduce breeding places. The activities that can reduce mosquito breeding are given below :

(a)Use sand to fill in pools, ponds, borrow-pits and hoof-prints in and around village.

(b) Remove discarded containers that might collect water.

(c) Cover cisterns (water tanks) with mosquito nets or leads.

(d) Clear away vegetation and other matters from the banks of streams- this will speed up the flow of water.

(e) Pools of water may be caused by leaking taps, spillage of water around stand pipes and wells or poor drains. These pools can be eliminated by repairs and improving to the water supply or drainage system.

(2) Chemical method : Chemicals are insecticides which either kills malaria mosquitoes or keeps mosquitoes away from the area where insecticides have been sprayed. Insecticides are effective method for mosquito control and widely used in

many parts of the world. Though it is learned that some malaria mosquitoes have developed resistance against some insecticides. Some commonly used insecticides are DDT, Malathion, Permethrin, Lambda-cyhalothrin etc. Insecticides are mixed with water and are sprayed through pressure sprayer. To control mosquito insecticides are sprayed as :

(i) Residual spraying : Insecticides possess residual properties. After spraying its residue remain on the surfaces where it has been sprayed. The effect of residue compounds lasts long which either kills mosquito or due to its odour mosquitoes do not come within the area where it is sprayed. Residual spraying is generally done in the houses. The effectiveness of one spray remains up to 3 months if the house walls are of wood planks. But porous walls made of unbaked clay or mud absorbs residue and reduces its effectiveness. Similarly, mud plastering in the houses after spray can reduce the potency of insecticides (Gilles and Warrell, 1993).

(ii) Space spraying : Space spraying is done by releasing insecticides into the air as smoke or as fine droplets. As result of which the numbers of mosquitoes reduce not only in dwellings but also temporarily in outside breeding grounds. By effect of insecticides mosquitoes are either die or due to its odour they fly away and do not come where it is sprayed.

(iii) Biological : This method of mosquito control is the introduction of various pathogens and predators of insect vectors of disease into the environment. Among various biological methods the use of larvivorous fish is common. Those fishes eat mosquito larvae. Cisterns, shallows, ponds, small streams, ornamental pools etc. are ideal places for mosquito control by fishes.

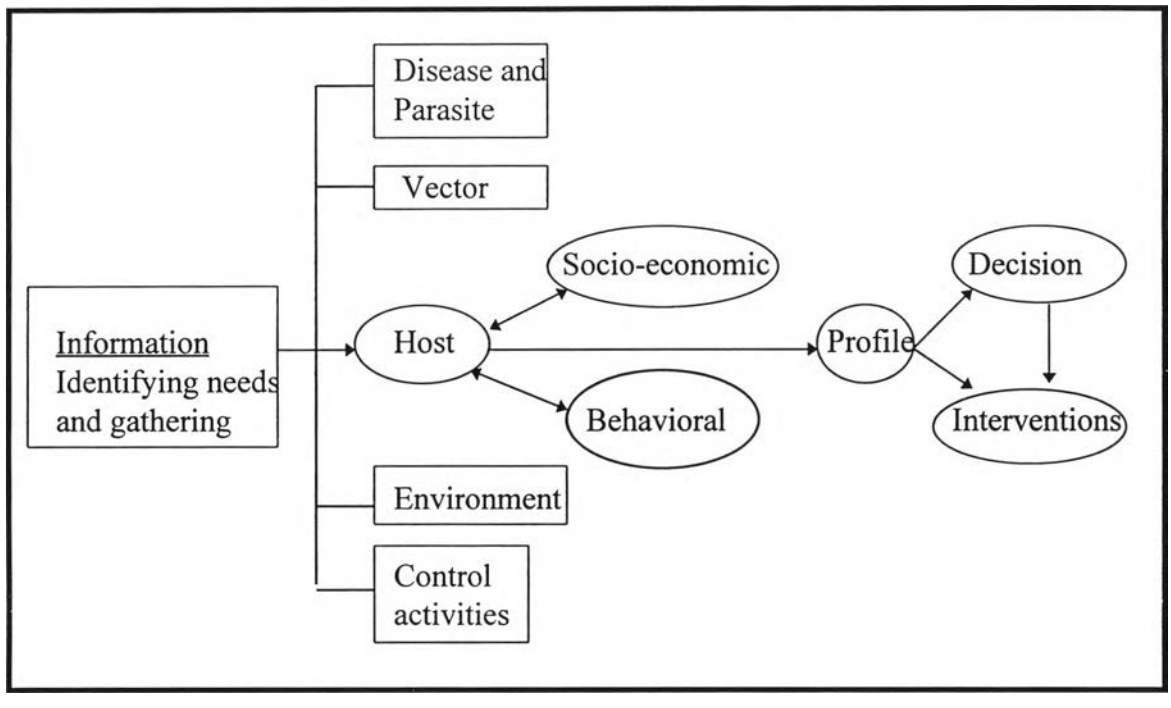
C. Antiplasmodial measures :

Antiplasmodial measures are use of antimalaria drugs after having illness with malaria. In the line of early diagnosis and prompt treatment of acute cases of malaria, blood smears from fever cases in the community are taken by village health volunteers and presumptive treatment is given to the fever cases by them. The slides are brought for confirmation of malaria parasite through microscopic examination in the health posts. According to parasite found, appropriate drug therapy are started.

In the area where localized or focal outbreak or in case of epidemics of malaria, all people living in that area are treated with antimalarials which is called mass drug administration. Similarly, for travellers, soldiers, policemen, workers in development projects who are coming from non-endemic areas short term-measures of chemoprophylaxis (treatment with antimalarials) is given. For laboratory confirmed cases radical treatment (confirmed malaria) with drug of choice is also given.

2.4. Analytical framework of the study :

Figure 2.2 : Required information for community malaria profile to undertake decisions and select intervention.



2.4.1. Required information for the selection of control measures :

1. Identifying information needs :

Good decisions require good information. For the selection of above mentioned control measures the first step is to identify information needs and then gather those information and analyze it. Those tasks can be performed through analysis of the malaria situation in a community (WHO,1997).

In this connection, decision makers and health service providers should first make a list of information that they require. Enlistment of information should be able to develop a clear picture of malaria situation which may called "Profile of malaria" (WHO,1997). Then they are expected to concentrate their attention towards the existing information and experience that they have and try to identify what information they do not have from the decision making point of view.

In this regard, WHO (1997) has outlined the type of information required in order to prepare a malaria profile in an area and has suggested to make a situation analysis to obtain the information. That are :

(A) Information on socio-economic and behavioral aspects of host (human) :

Of a malarious area, socio-economic information such as size of population, patterns of population distribution, people's occupation, mobility of population, types dwellings and income levels are important factors in selecting control measures against malaria. Similarly, behavior related to treatment seeking, environmental maintenance, personal and family protection, night time and community protection activities against malaria or mosquito also pose influence on malaria transmission and control.

Population size is important for the reason that it indicates the total number of people at risk. It helps to plan improvements of health facilities and the amount of anti-malarial drugs needed. Distribution of population indicates accessibility of people and rural and urban environment which helps to determine the type of surveillance and malaria control activities required. Occupation indicates the risk of acquiring malaria among different occupational groups e.g. farming, fishing, hunting, wood-cutting, wood gathering, cattle herders, sales persons etc. It is useful to find out who needs to know more about malaria and to know what control activities is required to them.

People's mobility increases possibility of malaria epidemics. Movements of cattle herders, travel from urban to rural areas, labor movements with development projects, dams, refugees are the examples of people's mobility. This information is useful to plan control activities and to allocate resources where they are most needed. The information on types of human dwellings and its location in relation to breeding sites is essential. Because open dwellings are difficult to spray, different ones need different mosquito net designs and proximity of breeding sites increase risk. This information will help planners to determine appropriate vector control measures. Income levels of people in a community indicates the ability to buy health care, protection measures and quality of dwellings. This information could be used to design cost-effective but equitable systems of health care supply (e.g. treatment, nets).

Behavior related to treatment seeking influences access to early and effective diagnosis and treatment. It may be used to identify barriers to obtaining early diagnosis and treatment and to determine information needs of the community and of health care providers. Similarly poor maintenance of canals and water pumps or poor drainage can create breeding sites for malaria mosquitoes. This information may be used to determine information needs of the community, water authorities and municipalities. Personal protection activities reduces human-mosquito contact (number of bites) so reduces transmission. The information on this activities may be used to determine materials and information required for community people. If people are outdoors during the mosquito biting time, their risk of infection is higher. So, this information may be used to protect children by suggesting when they should be indoors and using a net. Information on community protection activities indicates community's concern about malaria. This information may be used to support community efforts to arrange accessible health care, finance nets and insecticide, reduce breeding sites etc. An outline of required information on host (human) that to be collected as suggested by WHO (1997) has been given in Appendix VII.

(B) Information on disease (malaria) :

Information on disease pattern in an area is another important aspect of malaria control. Because endemicity, morbidity, mortality due to malaria, sex distribution of cases, parasite species, and drug resistance status are the factors which

help to determine the extent of transmission. Endemicity of malaria is helpful to determine the type of control activities needed and information on this can be used to make a plan of control measures. Similarly, information on morbidity (number of cases of disease per year) determines the scope of the problem and impact on the community which helps to plan health facilities.

Information on mortality (number of deaths from the illness per year) will also helps to determine the scope of the problem and impact on the community. It is useful to plan health facilities, to assess quality of health care and needs for training and improvements.

Sex distribution of cases (identifying the ratio of male to female) shows who is at more risk, where transmission occurs and immune status of population. This information can be used as if mainly males, it may be occupational, if pregnant women they should be focus of control efforts. Identifying the main parasite species that have caused malaria in the area and percent of each species will determine the treatment regimens. Because different parasite cause different degree of severity. If *P. falciparum* is predominant then there will be more complications and mortality. This information will tell planners to take quick action for health promotion for the rapid access of people to health services where *P. falciparum* is predominant. The information on drug resistance status tells the need for peripheral laboratory services. It also influences choice of effective drugs, effectiveness of self medication and cost

of drug provision. An outline of required information that to be collected on disease (malaria) as suggested by WHO (1997) has been given in Appendix VIII.

(C). Information on Vector (mosquito) :

Identifying information on vector (mosquito) is another important aspect in selection of control measures. Species of vectors, preferred breeding sites, biting habits and seasonal density changes could have implications in malaria transmission. Different malaria mosquitoes have different behavior which influences the mosquito control strategy. So, information on this will help to determine appropriate strategy. Similarly, different malaria mosquitoes breed in different water sites. Identifying breeding sites indicates which water bodies are important and whether larva control is feasible. It helps to decide which control methods to use, determines the role of community, other service sectors and industry and determines content of communication.

Malaria mosquitoes rest indoors and outdoors after blood meal. House spraying and insecticide treated nets may be more effective against indoor resters. Knowing resting habits helps to decide which control methods to use, determines the role of community, other service sectors and industry and determines content of communication. Malaria mosquitoes show different biting time, host preference and location. House spraying and insecticide treated nets may be more effective against

indoor biters and if people are inside at peak biting time. Information on this helps to decide which control methods to use, determines the role of community, other service sectors and industry and determines content of communication. Similarly, the density of vector population may vary from season to season. Seasonal density affects seasonal pattern of disease. This information helps to determine the content of communication and timing of control activities by communities and health sector. An outline of required information that to be collected on vector (mosquito) as suggested by WHO (1997) has been given in Appendix IX.

(D). Information on Environment :

Malaria is the seasonal disease. Malaria mosquitoes are found in the area where there is tropical and sub-tropical climate with adequate rainfall. Mosquitoes are not found in high altitudes where the climate is cold. So information on climate, rainfall, temperature, vegetation and topography is important because these affect suitability for transmission. This information will determine the mosquito control strategies and prediction of outbreaks. An outline of required information that to be collected on environment as suggested by WHO (1997) has been given in Appendix X.

(E) Information on control activities (by community and health services) :

Planners and administrators associated with malaria control programs should have an information on control activities such as types of health care, types of mosquito control, types of personal protection, availability of treatment protocols and outbreak control activities that are being undertaken by community and health services. Because, identifying the types of health care in an area like public health services, private sector, non-governmental organizations and list of all facilities, whether they have supplies, microscopes, staffs etc. would be important. Because these all contribute to provision of health care but vary in quality, accessibility and affordability. Those information are useful to provide the best access for all affected people to early effective diagnosis and treatment and to appropriate prevention. This is also useful to determine the content of communication to the community people.

Similarly, the information on types of mosquito control used by health services and community is important. Because different countries use different methods such as residual house spraying, occasionally outdoor ultra low volume spraying in towns or camps, chemical or biological larva control, removal of breeding sites or nothing. This information can be used to determine the content of communication to the people according to the control measures. Determining the types of personal protection helps to know acceptability and availability of personal protection measures like repellents, nets, coils etc. with people. Information on this

will help to build on current practices and make them more effective. The malaria treatment protocol provides best possible treatment guidelines to the users. Availability of protocols with drug providers and health providers indicates that they know the most appropriate treatment for the area. If it is not available with them then it is essential to train health providers and educate community people. In some areas outbreaks of malaria are increasingly important and can cause deaths. This information will help to involve community in reporting fevers and implementing control activities and helps to ensure drug supplies are readily available. An outline of required information that to be collected on control activities (by community and health services) as suggested by WHO (1997) has been given in Appendix XI.

2. Gathering information :

According to the information needs adequate and appropriate information should be gathered. Inadequate and inappropriate information could not be used for proper decision. It can be said that good information tend to good decisions, but not always, if decision makers do not analyze and apply information properly; if information providers do not provide right information; and, if information collectors do not collect adequate and appropriate information. Therefore, it is obvious that all those 3 categories who need and have information imparts equal role in gathering information. The first role is related with decision makers. They need to pay attention for what information they have and what they do not have in order to decide

an intervention. In addition, decision makers should specify the amount, type and applicability of information for that particular intervention that they are initially planning to implement. It should be noted that their initial planning must be based on the resources and technologies that they have. Otherwise it would not be a realistic plan and efforts done to collect information will be worthless.

The second important role is related with information collector or researcher. It is their duty to collect appropriate and adequate amount of information as demanded by decision makers. Inadequately and inappropriately collected information might be useless. It is also their duty to sought information from providers. How they collect the required and relevant information depends on how much skills to motivate people they have in order to pull information from them and how much deeper understanding they possess about people and community.

The information can be gathered using both formal and informal methods. But it should be noted that the source of information is community and people and they are the target of antimalaria programs. The initial step in gathering information may be to find out what the community calls malaria and what it knows about the causes and stages of illness. If community does not know about this then it should be noted as a gap in existing information and attempt must be done to let community know through communication.

For the collection of information we may use simple surveys or group discussions. Similarly, careful preparations of research methods such as interviews, direct observation, knowledge, attitude and practice surveys with people in the community can gather information. To obtain systematic information by this method special preparations are essential which include developing questionnaires or checklists, training interviewers, making logistical arrangements and selecting participants.

3. Developing a "Profile" of an area :

Based upon identification of information needs, information can be gathered using those data collection techniques to develop a profile of an area. A good information profile helps to understand the local problem which can lead to development of appropriate and effective strategies. The clear understanding of the problem and sharing this with the community will help in planning and in implementing better health promotion activities and appropriate community actions to control malaria in an area.

2.4.2. Required decisions for the selection of control measures :

1. Decisions for analysis of the malaria situation :

The initial step in any decision making is identifying the problem or opportunity and gathering facts about situation. The identification of problem or

opportunity can be done through gathering information and analyze it by situation analysis. So decision making for analysis of the malaria situation could be a decision that planners or administrators have to undertake at first. This analysis would include collection of relevant information on host (human), disease (malaria), vector (mosquito), environment and control activities by community and health services which are mentioned in above paragraphs (see page 24). The complete information received from situation analysis would give a picture of malaria situation of an area which will provide a basis for planning anti-malaria action.

2. Decisions to select intervention :

Based upon the analysis of the malaria situation key decisions need to be made regarding selection of intervention (see page 17 for the topic " Interventions to prevent and control malaria"). The selection of interventions should be made based on the information received from the analysis of situation along with the limits of permissibility (Is it legal? Will others accept it?), the limits of available resources, the limits of available time, and the limits of previous commitments. Similarly, opportunistic resources for antimalaria action and best possible alternative solution based on the resources should also not be overlooked alongwith the consideration that how can resources be mobilized.

The starting point for selection of an intervention for a given area can be done with the identification of epidemiological types of malaria within it. It will help to decide interventions because for the different epidemiological types, some interventions are accepted widely. For example, WHO (1993) in its global strategy for malaria control has suggested some control measures for those types as following :

Table 2.3 : Summary of main control measures for the major malaria types.

Malaria types	Main control measures
Highland fringe	(a) Provision of early diagnosis and treatment (b) Monitoring climatic and ecological changes (c) Early detection and control of epidemics
Plains and valleys	(a) Provision of early diagnosis and treatment (b) Sustainable vector control methods (c) Early response to situations of increased risk
Forest related	(a) Provision of early diagnosis and treatment (b) Personal protection measures (repellents/impregnated mosquito nets) (c) Chemoprophylaxis
Agricultural development	(a) Provision of early diagnosis and treatment (b) Personal protection measures (as above)
Urban and peri-urban	(a) Provision of early diagnosis and treatment (b) Environmental sanitation (c) Personal protection measures (as above)
Socio-political	(a) Provision of early diagnosis and treatment (b) Temporary chemoprophylaxis (c) Spraying of shelters (d) Personal protection measures (as above)

(Source : WHO, 1993. A Global Strategy for Malaria Control)

3.Decisions to obtain inter-sectoral CO-ordination and community participation:

Malaria control is inherently difficult in the sense that there are no general prescriptions that can be equally effective everywhere. Control measures vary from place to place which depend on local vector, parasite, environment and control activities being done by people, community and health service providers acting locally. Decisions regarding control requires a careful replanning. Therefore, planning for malaria control is clearly an intersectoral matter. Government health sector must note that control measures should be carried out carefully by establishing CO-ordination with other government sector, private sector and community. Regarding the process of decision for intervention the attention should be directed towards to establish inter-sectoral co-ordination. The availability and potentials of different sector of an area can be identified through the situation analysis mentioned above.

2.4.3. Socio-economic aspects of malaria :

Malaria has become a disease of developing countries where the socio-economic status of people is poor (WHO, 1993). At risk are poor people in both rural and urban areas. Due to their low income they can not afford and sometimes do not care for appropriate medication and personal protection measures appropriately. Sometimes they may have willingness for treatment but due to lack of transport

expenses they could not approach service outlets at the right time. People with low socio-economic status attempt seasonal migration for work into or out of malaria endemic areas where they either get infection or transmit infection (Agyepong et al., 1994). Migrants coming from non-malarious area to endemic area may have lack of immunity. Lack of malaria immunity among migrants will increase the risk of acquiring malaria infection or may fall into severe malaria illness.

Several socio-economic factors pose implications on malaria transmission as well as on the success of any intervention for control. These are rapid growth of population, agricultural practices, industrial development, urbanization, improvements in transport facilities, deforestation, irrigation, unemployment, labor force movement, and, resettlement and rehabilitation schemes (Kondrashin and Rashid, 1987). There may be other factors such as traditional occupational practices e.g. mining and wood-cutting unto forests which might have implications on transmission of malaria in an area. This will be discussed some more in detail in the following paragraphs.

Community participation may be a way to interrupt transmission and thus reduce malaria infection in the population where socio-economic conditions of people is low. People with low socio-economic status generally have less opportunity of education and with their low educational status they may not have knowledge on disease and breeding sites (Agyepong et al., 1994). Through analyzing their behavior

and socio-economic status, cost-effective control measures such as use of bed-nets, insecticide-treated bed-nets, reduction of mosquito be devised through community participation and awareness campaign. Socio-economic aspect, therefore, is an important factor in malaria control and transmission (Fungladda, 1991).

Socio-economic factors are the determinants of malaria transmission and control. Study have shown that malaria was more frequent in large households and among adults and males (Fungladda, 1991). People engaged in forestry activities for family income have shown a significant association with malaria prevalence and incidence. But use of bed-nets, insecticidal spray and anti-malarial drugs showed a strong negative association with malaria incidence in the households (Fungladda, 1991).

2.4.4. Socio-economic factors of malaria transmission :

1. Demographic explosion : Rapid population growth could be one of the factor responsible for malaria transmission in a country. Nepal's population growth rate at present is 2.08 (Statistical Pocket Book of Nepal, 1996). Out of many consequences of rapid population growth, one is to put pressure on agricultural land as well as raised demand of public health services. It tends to increase landless farmers promoting migration to urban areas which is increasing need for more number of health facilities (Kondrashin and Rashid, 1987). But the availability of facilities

could not be increased both in the population growth and people's migration ratio. This has caused a pressure for treatment of malaria but the insufficiency of service facilities, equipment's and drugs is affecting adversely being unable to meet the need and thus promoting malaria transmission.

2. Intensification and re-orientation of agriculture : Changes in agricultural practices could be a factor for increased malaria transmission. To increase agricultural productions, various efforts such as introduction of multi-crops system, construction of irrigation canals have being done in every developing countries where agriculture is main occupation. In Nepal, the economy is based on agriculture. Efforts of development in agricultural practice has resulted in the increased rice, wheat, tobacco, sugarcane productions (Statistical Pocket Book of Nepal, 1996). But steps taken for the agricultural development such as introduction of multiple-crop system and high yielding varieties of seeds generated a need of new irrigation projects and extensive use of pesticides and insecticides as a agricultural pest control measures (Kondrashin and Rashid, 1987). Surface irrigation by canals has provided breeding grounds for local malaria vectors. This has resulted in high densities and the prolonged longevity of vectors (Kondrashin and Rashid, 1987) contributing for malaria transmission.

In addition, some new areas are also opened for farming most often by clearing forests by landless farmers has resulted changes in mosquito fauna i.e.

changes of living place in the area. This may cause forest dweller mosquitoes which are initially living on animal blood to the human biters. Thus malaria vectors of forest region are enhancing local transmission (Kondrashin and Rashid, 1987) due to change in fauna in newly cultivated land where there was forest previously. High incidence of malaria in some village areas of Sindhuli, Sarlahi, Mahottari, Dhanusha districts of Nepal are some examples (Shrestha et al., 1991) which were forests previously.

3. Industrial development : Industrial development in Nepal is increasing. Plain areas of central, eastern and western parts of Nepal are more industrialized which are also malarious areas. Being an agricultural country there has been significant increase in agriculture-based industry like textiles, jute, sugar, cement, cigarette, brick-making. Other numerous cottage and small industrial units have also been set-up (Statistical Pocket Book of Nepal, 1996).

In those industrial regions, out of the total economically active population by major occupation, about 50% are working as farm and fish workers and about 3% are working as industrial labor (Statistical Pocket Book of Nepal, 1996). Laborer working in farm-fish industries are being a great threat to malaria. Looking at the rising trend of industrial establishment, industrial labor may pose a malaria problem (Kondrashin and Rashid, 1987). Because these industries are being established near

the forest fringes of plain areas. Originally these are malaria endemic areas. So future malaria problem to industrial labor can not be undermined.

4. Urbanization : Urbanization process may be responsible for malaria transmission. As a result of urbanization, different socio-economic and ecological changes take place. But the allocated resources of government may not be sufficient for maintaining every aspects of social standard in one hand and in other population movement will be rushed. Intensive population movements and low sanitary standards in the initial phase of urbanization may create favorable conditions for the transmission of vector-borne diseases. Kondrashin and Rashid (1987) have written urbanization and malaria transmission as:

"*Urbanization is a versatile process resulting in the concentration of both the means of production and the labor force along with substantial changes in the socio-demographic structure of contemporary society. Under the influence of urbanization different ecological changes take place in the community as well as in the environment. Natural and socio-economic conditions in the urban areas of the majority of developing countries are extremely favorable for the establishment of local malaria transmission.*"

In Nepal, urbanization process is rapidly growing and malaria is found endemic in newly developed urban areas. The example may be taken as the study area of this project i.e., Panchkhal village, which is progressing to become urban.

5. Improvement in transport facilities : The vigorous improvement in transport facilities through construction of road system has facilitated population movements. This helps for the dissemination of malaria in the several parts as well as exposure of

road construction workers to the disease. In Nepal, in 1956-61, there were only 624 Km of black-topped roads. In mid July of 1993 the total road built was 9,534 Km and the construction works of several roads are in progress at present (Statistical Pocket book of Nepal, 1996). Thus this may lead construction workers to the threat of malaria.

6. Deforestation : Deforestation activities are also responsible for malaria transmission. Population growth is also rising pressure for deforestation. Forests are converting into agricultural lands in developing countries. Use of firewood as domestic fuel is also responsible for deforestation. In Nepal, 87% of total population and 95% of the rural population meet their energy needs from forest (Shrestha et al., 1991). Deforestation causes shifting of forest-dwelling species of *Anopheles* mosquito to household feeder (Kondrashin and Rashid, 1987). High incidence of malaria in forest fringe areas of Nepal in several districts (Dhanusha, Mahottari, Sarlahi, Sindhuli districts) are the examples malaria due to deforestation (Shrestha et al., 1991).

7. Irrigation : Irrigation facilitates malaria transmission. It makes surface water-table which is a favorable place for mosquito breeding. Similarly, it also makes water bodies in farming fields where irrigation facilities is available making a favorable place for mosquito breeding. There is increasing irrigation construction works in Nepal. In 1956/57 total irrigation capacity was 6228 hectares in Nepal. But

it increased to 728,985 hectares in 1994/95 (Statistical Pocket Book of Nepal, 1996). Several other irrigation projects are being built-up. This shows that there is a increased threat of malaria transmission.

8. Labor force movement : Movements of population here and there in order to seek employment opportunities may increase the risk of acquiring malaria. Many factors tend to population movements. These are unemployment, labor movements and migration of population. The viscious circle of population growth, increased family size, unemployment, marginalization of rural holdings, poverty have created situation where it led for labor force movements from one place to other in search of livelihood (Kondrashin and Rashid, 1987). Industrial developments in urban areas are attracting people for migration in order to find work and earning. Kondrashin and Rashid (1987) state, "population migration has been associated with the building-up of a high malaria potential as a result of exposure of the population to a new environment"

People migrate in search of occupations in agriculture, developmental projects, mining, exploitation of forest resources, cattle grazing, fishing, nomadism. In Nepal during non-agricultural season people migrates from hills and mountains to plain areas which are malarious areas. Migration of seasonal labor is upto 70% (Kondrashin and Rashid, 1987). Every year about 1 million Nepalese labor force move to the highly malarious north-eastern States of neighbor country India for

the search of work. Similarly, Indian labor come to Nepal for work. Open border and non-requisition of passport and visa provisions has made it easier for the exchange of labor force between Nepal and India. About 25% of imported cases out of total 9609 national cases have been reported in 1995 which is the example of malaria transmission by labor migration in Nepal (Dept. of Health Services, 1996).

9. Resettlement and Rehabilitation Schemes : People usually move from remote areas to the plain fertile lands and valley for several socio-economic reasons. Poverty, disaster, government policy or political causes tend people to do so. Government of Nepal has laid a policy to rehabilitate landless peasants, orphans and political sufferer. They are being resettled in the plain areas of Nepal which are originally a malarious areas. But these population may not have malaria immunity. Because they might have come from high mountains which are originally non-malarious areas. It is found that people living in malaria endemic areas develop some degree of natural immunity because of continuous exposure with malaria. If there is lack of immunity against malaria the risk of acquiring malaria might be high and may get severe malaria illness. In addition, about one hundred thousands Bhutani refugees are resettling temporarily near the forested plain areas of Nepal where 1461 cases of malaria were reported among them during the year 1995 (Dept. of Health Services, 1996).

2.4.5. Human behavioral aspects of malaria :

Behavior is an important determinant of health. Behavior can influence health directly and indirectly (Green and Kreuter, 1991). Behavior such as smoking, diet, drug misuse, lack of exercise etc. are risk factors to health and are causes of disease and death. Factors that increase the probability of developing a disease or health problem are called risk factors (Green and Kreuter, 1991). A risk factors may be an aspect of personal behavior or life style or inherited characteristics known to be associated with health related condition (Fungladda and Butraporn, 1992).

The success of intervention of any health program depends on people's active participation and which is determined by the behavior of target group. Behavior is an indicator of health or quality of life outcomes. Because, it determines a person's years of potential life (Green and Kreuter, 1991).

In a community survey of people, who engage in selected behavioral risks, in Toronto, Canada found that 50 per cent of premature mortality (years of potential life lost) is attributable to health behavior. Behavioral risk factors are associated with 12 leading causes of death (Green and Kreuter, 1991). The results of the survey has been used to guide health policy and programs to meet the needs. So, it can be concluded that human behavior determines types, extent of disease transmission and identifies the requirements of health interventions. Health planners should take

consideration of human behavioral factors before devising any intervention program to improve any health problem situation of a community. Fungladda and Butraporn (1992) have described a malaria-related behavioral risk factor as:

"A malaria-related behavioral risk factor can be regarded as any action that has emanated from the combine effects of knowledge, practices and attitudes of an individual or group which increases the probability of the occurrence of malaria"

Health behavior of people regarding malaria in malarious areas plays a significant role in malaria transmission. Because, health behavior is mostly related to prevention of human-vector contact. People's daily or seasonal activity patterns such as working in farms, working at night time can maximize the contact with malaria vectors. The elements of human behavior, therefore, are important determinants in malaria transmission.

2.4.6. Behavioral factors in malaria transmission :

Success of any malaria control strategies depend on the behavior of patients and caretaker (McCombie, 1994). Fungladda, (1991) has categorized malaria behavior in two types - deliberate and non-deliberate which are presented below :

Table 2.4 : Classification of behavior in relation to malaria.

Deliberate	**Non-deliberate**
1. Consciously health-related behavior that serve to promote or maintain health e.g. compliance with drug therapy.	Behavior not perceived as the health related but enhancing or maintaining the level of health e.g. housing construction, preferences (screening), or other arrangements to deter mosquito-biting.
2. Behavior that contributes to ill-health or mortality e.g. voluntary migration and settlement in malaria endemic areas despite of awareness of risk of contracting the disease.	Behavior that contributes to ill health or mortality, e.g. occupational migration to forested areas for gem mining or wood cutting.

Elements of human behavior that affects transmission of malaria are self-treatment, delays to treatment, having adequate treatment, personal and family protection and maintenance of living environment from mosquito nuisance. Those behaviors are affected by cultural beliefs, accessibility to the health facilities and its availability, affordability of treatment and availability of protection measures, availability of goods and services, knowledge about malaria fever, acceptability of control measures and sources of treatment (formal and informal health sector) etc.

Cultural beliefs about the cause and cure of illness is an important factor affecting human behavior. Disease considering as god curse and to rely on worships of god taking help of priest and traditional healers for the cure are some examples of belief currently in practice in Nepal. In the remote rural areas of Nepal disease like Chickenpox and goiter are considered as god gift. Though there is lack of evidence to establish this belief in terms of malaria in Nepal since no study is available now.

Some contemporary study mentioned in the following paragraphs has shown that how risk behaviors contribute for malaria transmission and ill health.

A survey was conducted in two villages of the same malaria endemicity but different levels of transmission in Lamae District, Chumphon Province, southern Thailand with the aim to study whether behavior of people to malaria was similar or not (Ittiravivongs et al., 1992). The study revealed that during the low transmission period behavior related to chemoprophylaxis and use of bed nets was similar in both villages whereas risk behavior of night work was significantly higher in one village than the other. This was likely due to their different principal occupations such as farming of rubber plantation in one village and coffee plantation in other village. During the high transmission period there were significant decrements related to night work and significant increments related to bed-net use in both village. The study showed that different behavior such as treatment seeking, personal protection behavior and risk behavior (night work) are attributable for different levels of transmission (Ittiravivongs et al., 1992).

Similarly, a study, conducted in four villages of Chanthaburi and Trat Provinces, Thailand with an aim to investigate preventive behaviors among mobile villagers, reveals that behavior of population movements into potential transmission sites contributes to active transmission (Butraporn et al., 1995). So the study

concludes that the periodic movement behavior of population is a high risk factor because it exposes people to malaria vectors (Butraporn et al., 1995).

In a study of human behavior in relation to selection of malaria treatment when they became ill with malaria in villages of Pong Nam Ron and Bo Thong Districts of Thailand, showed that 87-94% of the study subjects gave a history of having used a local preparation of anti-malarial drug under the name of *"ya-chud"* in the past (Kamolratanakul et al., 1992). The study reveals that the *"ya-chud"* is composed of 3-5 unnecessary drugs and such improperly use of anti-malarial drugs in malarious areas can result in treatment failure and cause the development of drug resistance (Kamolratanakul et al., 1992).

So risk behaviors and risk factors that attributes for malaria transmission are nocturnal social or working activities that people enjoy early part of the night, sleeping outdoors or sleeping without a bed-net (Sornmani, 1992). This type of behaviors facilitate human-vector contact and the transmission of malaria is the result of man-vector contact.

Due to economic constraints and limited job opportunities people undertake migration to the malarious areas where there is chances of getting jobs. This behavior due to economic crisis are prevalent into countries of Southeast Asia (Sornmani, 1992). In fact, people's behavior such as whether they seek late treatment when

suffering from fever or malaria; whether they maintain their living surroundings and housing conditions to reduce breeding sites of mosquito; and, whether they use personal and protection measures like screening of windows and doors, bed-nets determines malaria transmission. Beliefs, taboos, customs, avoidance of authorities, poor economic status could tend to practice these behaviors (Oemijati, 1992).

Out of different human behaviors, the important elements with respect to malaria transmission in a community may be :

- treatment seeking behavior if suffered from fever or malaria.
- taking care for personal and family protection from mosquito nuisance.
- maintenance of physical environment and housing conditions to control mosquito nuisance.

2.5. Global malaria problem :

Malaria still stands as a serious global public health problem affecting all age group in many parts of the world. Since it is found in tropical and sub-tropical topography, it is widely spread most parts of the Africa, Asia and in some parts of Europe, and America within the temperate zones (Park 1994, WHO 1997). The disease is no longer endemic in the area where there is social and economic improvements or in developed world (Park, 1994). Nowadays it is a major public health problem of developing world commonly affecting people of low socio-

economic status. Each year between 300 to 500 million people in the world fall ill with malaria and 1.5 to 2.7 million die from this disease (WHO, 1997). Most of cases and deaths occur in Africa, Sub-Saharan Africa where 1 million death occur annually in children less than 5 years old. It constitutes a leading cause of pregnancy complications and a result of which low birth weight, neo-natal mortality and anaemia in that region (WHO,1997). Asia accounts approximately 4 million of cases per year (WHO, 1997).

2.6. Nepal

2.6.1. Malaria situation :

Out of Nepal's total 75 districts, malaria has been observed fully or partially in 67 districts, though the government control program at present is active only in 56 districts (Joint HMG/WHO/USAID Assessment Team, 1994). Among total 20.32 million population (an estimate of 1995 by annual increment of 2.1 %, Statistical Pocket Book, Nepal, 1996) approximately 13.17 million (65 %) are at malaria risk (Dept. of Health Services, 1996). Urban malaria in Nepal is virtually non-existent (Joint HMG/WHO/USAID Assessment Team, 1994).

Looking at the overall national malaria situation, total detected positive cases in 1993, 1994 and 1995 were 16368, 9467 and 9609 respectively. Out of those

6510 were indigenous, 2178 were imported and 834 were P. falciparum cases in 1995. (Dept. of Health Services, 1996).

2.6.2. Climate :

There are 3 climatic zones in Nepal. They are sub-tropical (Plains and inner plains), temperate (hills and valleys), and alpine (extreme cold areas and Himalayan region). Temperature varies according to seasons. But, temperature in sub-tropical regions usually remains 4 to 40 degree Celsius, in temperate zones zero to 40 degree in summer and winter seasons respectively. There is extreme cold in alpine region having temperature under zero scale mostly in all seasons. Eighty percent of the total rainfall occur during rainy seasons. The average rainfall is 1,500 to 2,500 mm through out the country and maximum is over 6,000 mm. Tropical and temperate regions are rainy areas but amount varies within place to place.

Nepal's climatic conditions in terai (plains) and hills are favorable to the transmission of malaria. Since, malaria is a seasonal disease, the maximum prevalence is from July to September (Kondrashin et al., 1987) which is rainy season. Most of the malaria prevalence in Nepal are found in tropical and temperate region since, these areas are climatically suitable for vector breeding (Dept. of Health Services, 1996).

2.6.3. Magnitude of malaria in Nepal :

1. Area, vector system, endemicity and population at risk :

Based on the eco-epidemiological situation, all malarious areas of the country have been classified into five strata by malariogenic- potential or receptivity for operational purpose. The population and areas at risk in each stratum, vector system and endemicity is given below :

Table 2.5 : Area classification, vector system, endemicity and population at risk from malaria in Nepal

Stratum	Area	Vector system	Endemicity	Popula-tion at risk (million)	% of popula-tion (out of total 20.32 M
I	Foot hills, forest fringe & inner terai	*An. fluviatilis, An. maculatus*	Hyper endemic, high *P.falciparum*	1.28	6.29
II	Foot hills, fringe & inner terai	*An. fluviatilis, An. maculatus*	Mod. endemic, *PF* low vulnerable	3.04	14.94
III	Plains, cultivated outer terai	*An. Annularis*	low endemicity	5.36	26.4
IV	Hills valleys	*An. fluviatilis, An. maculatus*	low transmission spells	2.63	12.9
V	Hill areas without anti-malaria action	*An. Maculatus*	Occasional outbreaks	0.87	4.3

(Source : Kalra et al., 1992, SEARO/WHO and Dept. of Health Services, 1996)

2. Sex wise distribution of malaria cases :

Table 2.6 : Year and sex wise distribution of malaria in Nepal

Year	Total cases	Male	Female
1993	16404	67.6 %	32.44 %
1994	9912	69.68 %	29.68 %
1995	9609	68.42 %	31.57 %

(Source : Dept. of Health Services, 1996)

3. Age wise distribution of malaria (in the year 1995) :

Table 2.7 : Malaria among the age group in 1995 in Nepal

Age group	Percentage (total malaria cases 9609)
Infants	0.32 %
1 - 4 years	3.80 %
5 - 9 years	7.50 %
10 - 14 years	11.2 %
15 - above years	77.2 %

(Source : Dept. of Health Services, 1996)

4. Vector System :

Among different species of *Anopheles* mosquito, four types namely *An. maculatus*, *An. fluviatilis*, *An. annularis* and *An. minimus* is responsible vector for malaria transmission in Nepal (Kondrashin and Rashid, 1987). Most of transmission

are by *An. fluviatilis* and *An. maculatus*. *Plasmodium vivax* is the most predominant parasite species through out the country which accounts about 80 % of all cases. Rest are *P. falciparum* with few *P. malariae* cases (Kondrashin and Rashid , 1987).

2.6.4. Infrastructure for malaria control in Nepal :

At the central level the Epidemiology and Disease Control Division (EDCD) under Department of Health Services (DoHS) is solely responsible to carry out the disease control management activities throughout the country through the different levels of health facilities under DoHS.

Under EDCD there are 3 sections. These are Disease Control Section, Natural Disaster Management Section and Management Information Section. Among these the Disease Control Section mainly looks after vector-borne disease control like Malaria, Kalazar and Japanese Encephalitis control program (Organizational Structure of MoH, 1993).

2.6.5. Information system of malaria in Nepal :

An important aspect of successful program is a well developed information system. For disease, collection of information is surveillance. In malaria,

surveillance is the "collection of information for action" (EWARS Guidelines 1996, DoHS/EDCD). Information collection is required to :

- identify nature, scope, size, risk, potentials and prioritize problems.
- determine actions needed, i.e. planning and decisions.
- allocate resources and evaluate the impact of control measures.

Surveillance in malaria in Nepal is aimed at early diagnosis and prompt treatment of cases. At present, surveillance in malaria is passive and active case detection (Dept. of Health Services, 1996). About 4870 passive case detection volunteers (PCDVs) throughout the country are involved in taking blood slides from fever cases in villages of Nepal (Joint HMG/WHO/USAID Assessment Team, 1994). Their contribution accounts for 73 % out of the total detected positive cases and constitutes 38 per cent share on total blood slide collection (Dept. of Health Services, 1996).

For active case detection village health workers (VHWs), a local health post staff, are being involved. They frequently visit villages and collect blood smears from fever cases as well as take over slides from PCDVs with contacting them. Blood slides collected from both is brought to health post for microscopic examination.

2.6.6. Problem and constraints :

The available information on malaria situation at present has not covered all the aspects of malaria epidemiology. Epidemiological information such as types of vectors in the area, their habits and habitats, parasite types and areas, annual parasite incidence, annual blood examination rates, slide positivity rates are available even at the village level. But information on the host, about their socio-economic status and elements of behavior such as village at malaria risk, location, pattern of population movements or migration, agricultural practices, pesticides use, water works, occupation, irrigation, treatment seeking behavior, personal and family protection behavior from mosquito nuisance, behavior towards the maintenance of physical environment and housing conditions from the mosquito nuisance etc. affecting transmission are not available (Joint HMG/WHO/USAID Assessment Team, 1994). On the ground of non-availability of those information, government's present measures for malaria control have been found unable to reduce transmission in many endemic areas to the level of national target. If there were malaria profile, appropriate interventions could have launched to improve malaria problem based on those information.

Patterns of migration have been mapped out by identifying cases imported from neighboring countries. Migration to the areas of new development projects within the country and to endemic areas of neighboring countries are not carried out

since these requires special studies (Joint HMG/WHO/USAID Assessment Team, 1994). Since the community malaria profile contains information on that aspects, it would have helped to design a suitable anti-malaria measures for migrants if there were a malaria profile.

With the limited resources, technologies and technical manpower, government of Nepal is unable to conduct a regular study on the socio-economic and human behavioral aspects of malaria transmission in most of the places. This has led non-availability of local malaria information profile on that aspect of many prone-areas. As it is already felt fact that there should be a malaria profile of every prone-areas to adapt appropriate control measures suitable as per local situation (WHO, 1997).

Previously, regular monitoring of the situation was being done by the technical and financial help of INGOs. But from the last few years for the several reasons, major donors either reduced funding or diverted their interest in other sectors. This has further added an obstacle to carry out socio-economic and behavioral research (Joint HMG/WHO/USAID Assessment Team, 1994).

2.7. Conclusion :

The need for a simplified socio-economic and behavioral profile of malaria in different problem areas has been already recognized (WHO, 1997). The important role of human behavioral, social and economic factors in the epidemiology of malaria have also long been recognized as conducive factors for malaria transmission and influencing factors in control of malaria. Yet we remain relatively ignorant of the social and economic effect of malaria in those countries where it is most prevalent. The consequences of ignoring human behavior has resulted in less efforts by people in treatment seeking. Similarly, socio-economic factors largely influence on treatment as well as in transmission. It is also mentioned in the above paragraphs that at present there is lack of such profile on socio-economic and behavioral aspects of the malaria problem areas in Nepal. It is essential to understand the dynamics of malaria transmission with particular reference to its persistence for the development of suitable control measures. So, to prepare a socio-economic and behavioral community profile of malaria a study is proposed to be conducted in one of the most malarious village of Nepal. The profile will aim to assist in decision making and in preparing plans of actions to interrupt transmission. Looking at the present trend and dynamics of malaria transmission in Nepal regular studies should be carried out to update the information profile of a community on socio-economic and behavioral aspects of each malarious areas which enable us to know prevailing risks and potentials of malaria transmission.

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