Health Impact Assessment
Guideline for
Water Resources Development Project
In
Thailand

Ministry of Public Health
Kingdom of Thailand

Preface

Health Impact Assessment Guideline for Water Resources Development Project in Thailand is conducted to facilitating and enhancing the incorporation processes of health impact assessment into the report of environmental impact analyses to suit the set of government policy that the health impact assessment is an integral along with the analysis of environmental assessment processes. Notification under this circumstance can be seen from declaration of The Ministry of Natural Resources and Environment about the categories and size of projects or activities that the report of analysis of environmental impact must be submitted. The principle, methodology, regulations and guidelines for reporting the environmental impact analyses were announced in the Royal Thai Government Gazette dated 31st August 2552 (BE). The announcement set comprised 34 projects or activities that the health impact assessment must be incorporated in the report of environmental impact analyses. At the same time, the Constitution of The Kingdom of Thailand 2550, Article 67 (2) has setup the condition for the projects or activities that are found potentially sound to cause severe adverse affect on community, environmental quality, natural resources and health: Shall not be made **unless the impact of environmental quality and health of the inhabitants in the community are studied and assessed, and the process of hearing from the people or local residents and the stakeholders must be setup, priory.** Including given authorities to Non Governmental Organization (NGO) in which consists of the representative from private organization in environmental and health, and the representative from higher educational institute(s) where they perform environmental study or natural resources or health aspect to share their opinion prior proceeding the process of project. Water Resources Development Project is the one of among 34 different project types that must perform health impact assessment to include in the environmental impact analyses of these include large scale water resource development that might be its project or activities that can lead to the severe adverse affect on health in the community.

The Ministry of Public Health has direct responsible commitment in developing the knowledge of Health Impact Assessment (HIA). Thus, this Guideline of Health Impact Assessment for Water Resources Development Project in Thailand is established by cooperation from professions and related official units along with organizing seminars to hearing for opinion from various agencies and person involved in many occasions in order to scoping the frame work of studying, indicators and guidance of impact assessment to cover in all dimensions of health aspect including the preparation of guideline for prevention, correction and mitigation the impact and appropriate way to following and checking up for water resources development to give those who are involved in the study of health impact assessment can use as a practice guidance suit to the intent of the constitution in the next future.

Editorial group

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Chapter 1

Introduction

1.1 Objective of Guideline of Health Impact Assessment for Water Resources Development Project:

1.1.1 To suit the intent of the Constitution of the Kingdom of Thailand 2550, Article 67 (2)

1.1.2 To use as a tool in the development of knowledge, to understand the principle, way of though of health impact assessment from water resources development, ability of applying for integrated analyzing environmental impact and leads to seeking for an appropriate mitigating and monitoring measures beyond.

1.2 Target group:

1.2.1 Project owner

1.2.2 Health impact assessment personnel

1.2.3 Related responsible offices or agencies

1.3 Constituents of assessment framework

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Chapter 2: Principle and process of examination of health assessment report

Chapter 3: Step and methodology of health impact assessment and report preparation

Annex : Illustrative example of health determinant data in water resources development project:

Example the effects of dam project, references, example the people interview form in health behavior aspect, the study on the situation of helminthiasis and protozoal infection in the water resources development project and etc.

1.4 Important definitions involve in health impact assessment

1.4.1 Large scale water resources development refers to dam or water reservoir that capable to collect water from 100 million cubic meters and over or have the area of collecting water from 15 square kilometers and over or have the area of irrigation from 80,000 rais and over or dam/water reservoir body/ irrigation is situated in the extension reserved forest of which the constructing value over 200 million baht or dam/water reservoir body/ irrigation of all size is in the area of first class river basin.

1.4.2 Health refers to “the state of human being which is perfect in physical, mental, intellectual and social aspect all of which are holistic in balance” (The National Health Act. 2550)

1.4.3 Health determinant refers to the boundary factors of an individual, social, economy and environment that determines health status of individual or population (National Institute for Health and Clinical excellence, NIHCE, 2006) (Annex 1)

1.4.4 Health status refers to the condition of physical, mental of human being including state of wellbeing, impairment of health, illness or injuries of the people

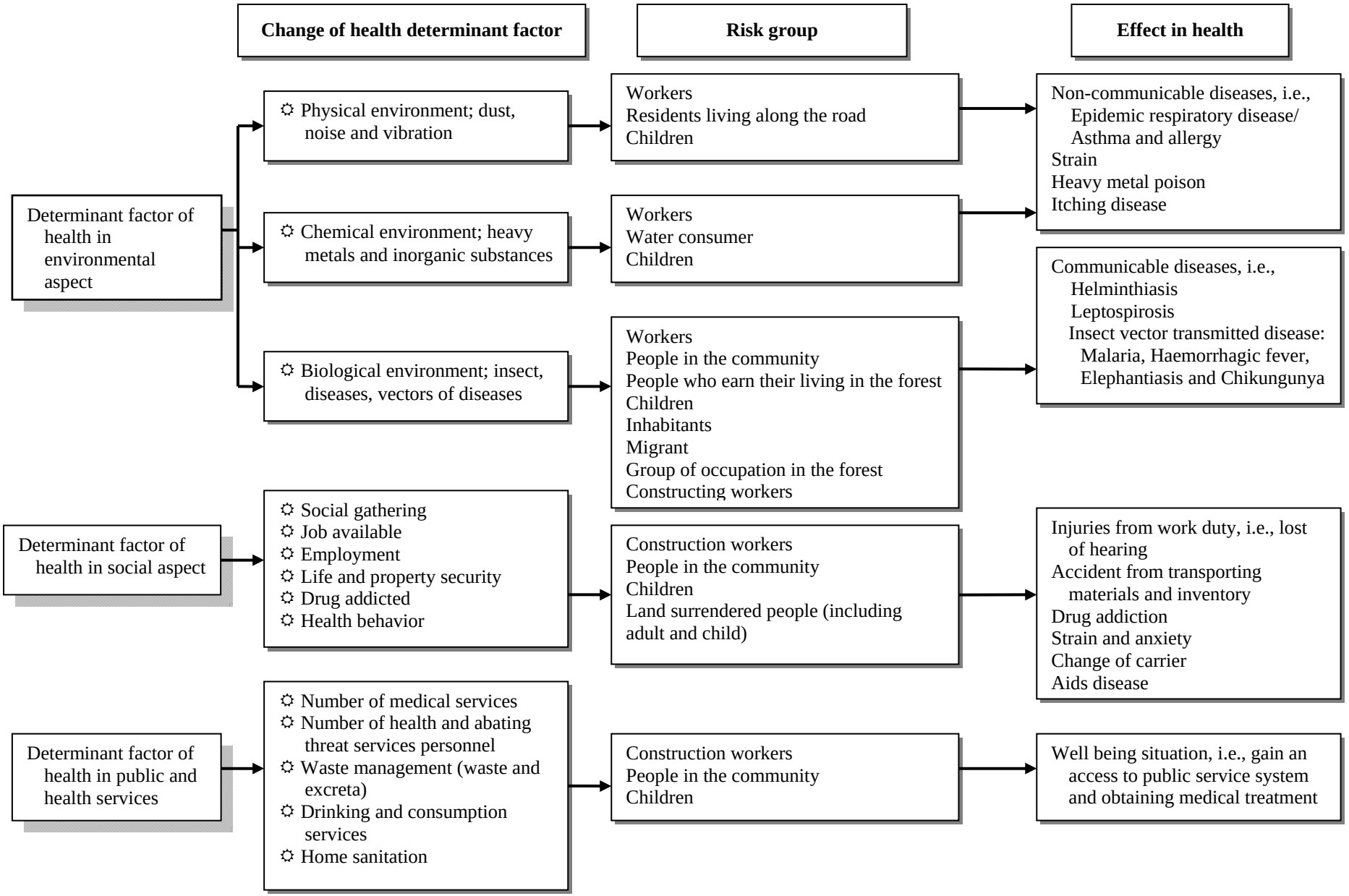
1.4.5 Health impact assessment (HIA) refers to systematic approach to predicting or forecasting the potential positive and negative effect on health by using process, methodology and other tools combined in order to make proposal in term of prevention and mitigation the impact on health that might be caused by the project including the proposal of impact enhancement for health promotion leading to the process of determination for project development.

1.4.6 Risk group refers to infirmity or fragile groups to infection or sickness, accident, injuries, nutrition and mental (must be consider in child group 0-5 years of age, pregnant woman, incapacitated person, senior citizen and sensitive group of touch) and the inhabitants who live in the impact area as for example the one who loses the land used, change of occupation and migration.

1.5 Conceptual framework of health impact assessment from water resources development

Health impact assessment is the prediction of both positive and negative effects on health from water resources development project by considering in all aspects impact and dimensions of both in width and depth in order to show the connection of event factors and the impact that might be occurred during each period of time how to resulting in the change of health determinants. The assessor must carefully be consider about health determinant in environmental aspect (physical, chemical and biological), social health determinants (social gathering, employment, safety of life and property, drug addiction, health behavior and health determinant in public and health services aspect (number of health center, number of health personnel) abating of public hazard services, waste management (waste and excretion) drinking water services and home sanitation. Besides the set of health determinants mentioned above, the assessor must also be consider about water related diseases, i.e., **1. Water-related insect vector disease**: Of these are malaria, haemorrhagic fever, elephantiasis and etc. **2. Water- based disease** which are comprised helminthiasis and protozoal infection. **3. Water-borne disease:** causes by consumption of contaminated water with man and animal excreta containing bacteria, viruses such as Asiatic cholera, dysentery, typhoid, and diarrhoea, etc and, **4. Water-washed disease** due to lack of clean water to clean body and washing clothes result in contamination by direct or indirect contact. Of these diseases are red eye and itching. The details are illustrated in the Figure 1.

Figure 1 Illustrating the frame work of impact assessment on health



Chapter 2

Principle and Process of Determination of Health Impact Assessment Report

2.1 Principle of health impact assessment

1) The usage of data, evidence from the process, methods and other tools combined for forecasting the effects in health that might be happen in both positive and negative

2) Study on how basal health and change of environmental and social characteristics to cause effect on health

3) Presentation of preventing and mitigating measures to reduce the negative impact, and health promotion or the enhancement of positive impact

4) Stressing on participating right of people in the process of health impact assessment to participate in determining appropriate choice and be together with the development, peacefully

5) Focusing on disadvantage or vulnerable and high risk groups

6) Integration concepts of physical, mental, social and wisdom

2.2 Water resources development project to study and health impact assessment report preparation

The water resources development projects that need to study and have to prepare health impact assessment report are the projects within the scope of:

1) The water resources development projects which are required to submit the analyzing report of environmental impact assessment (EIA) according to the mandate of the Ministry of Natural Resources and Environment (MONRE) about the specified type and size of the projects or activities that must prepare the analyzing of environmental impact report, and rules, methods, operating procedure and guideline of report preparation of environmental impact analysis. Dated 20 January 2552 comprises:

(1) Dam or water reservoir project which its capacity of water collection over 100 million cubic meters or the surface area of water collection more than 15 square kilometers

(2) Irrigation project that cover the irrigation area more than 80,000 rais

(3) All types of projects that are situated in the area where the cabinet approved to be an area of first class level of river basin quality.

2) The water resources development project type that fall into scope of cabinet approval under the National Environmental Board (NEB) resolution dated 13 September 2537 concerning in principle of permission in making benefit or living in the area of national reserved forest which is connected to the area of the forest for conservation

2.3 Process of health impact assessment report determination

The process of report determination in health impact assessment (HIA) will be used the same process as of the determination report of environmental impact assessment (EIA). The project types of the state, the state enterprises and the private cooperative that need to submit to get approval from cabinet, agency of the project owner or the project proponent or the developer are required to prepare health impact assessment report integrate into the report of environmental impact assessment propose to Office of Natural Resources and Environment Policy and Planning to bring up to Expert of Water Resources Development Committee, and have Honorable Public Health Committee to review in the of aspect of health impact before further proceeding or prior to be brought up to the National Environmental Board in which the Office of Natural Resources and Environment Policy and Planning acts as the secretary of the board to express an inference of opinion to supporting the determination of cabinet to the point beyond. All this, the cabinet may ask opinions from individual or institutional body for supporting the consideration to the project approval. The timeline used for the determination in all types of project mentioned previously is not stipulated in the regulation. The step of report determination is presented in Figure 2-1 below:

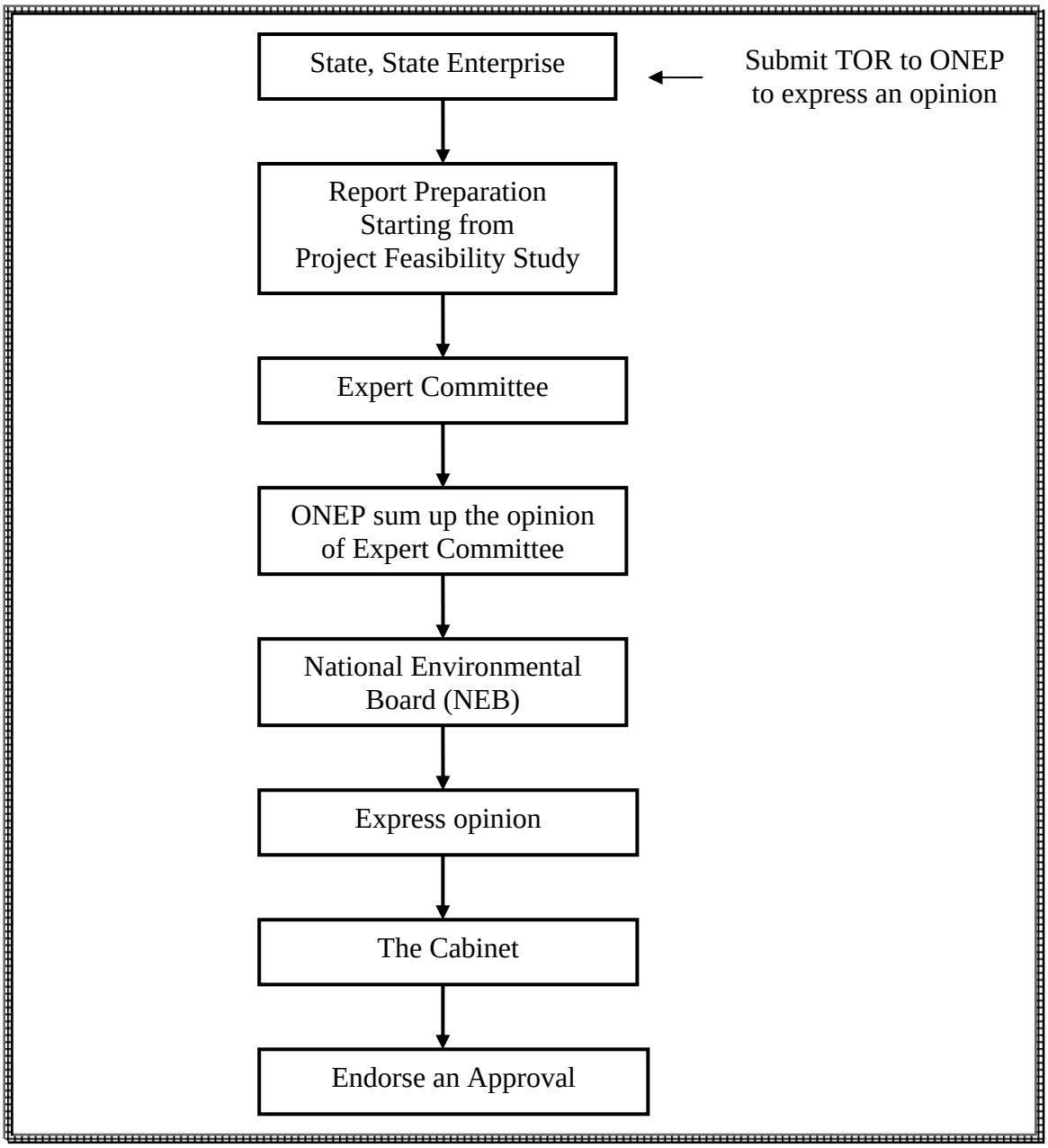


Figure 2-1 Step of determination for the report of analyses of the environmental impact in the case of the state, the state enterprise and the private cooperative projects that need to submit to get an approval from the cabinet

Chapter 3

Step and Procedure of Health Impact Assessment and Report Preparation

The procedures of health impact assessment are described 5 steps and listed as follows:

1. Screening
2. Scoping
3. Appraisal
4. Report and recommendation
5. Monitor and evaluation

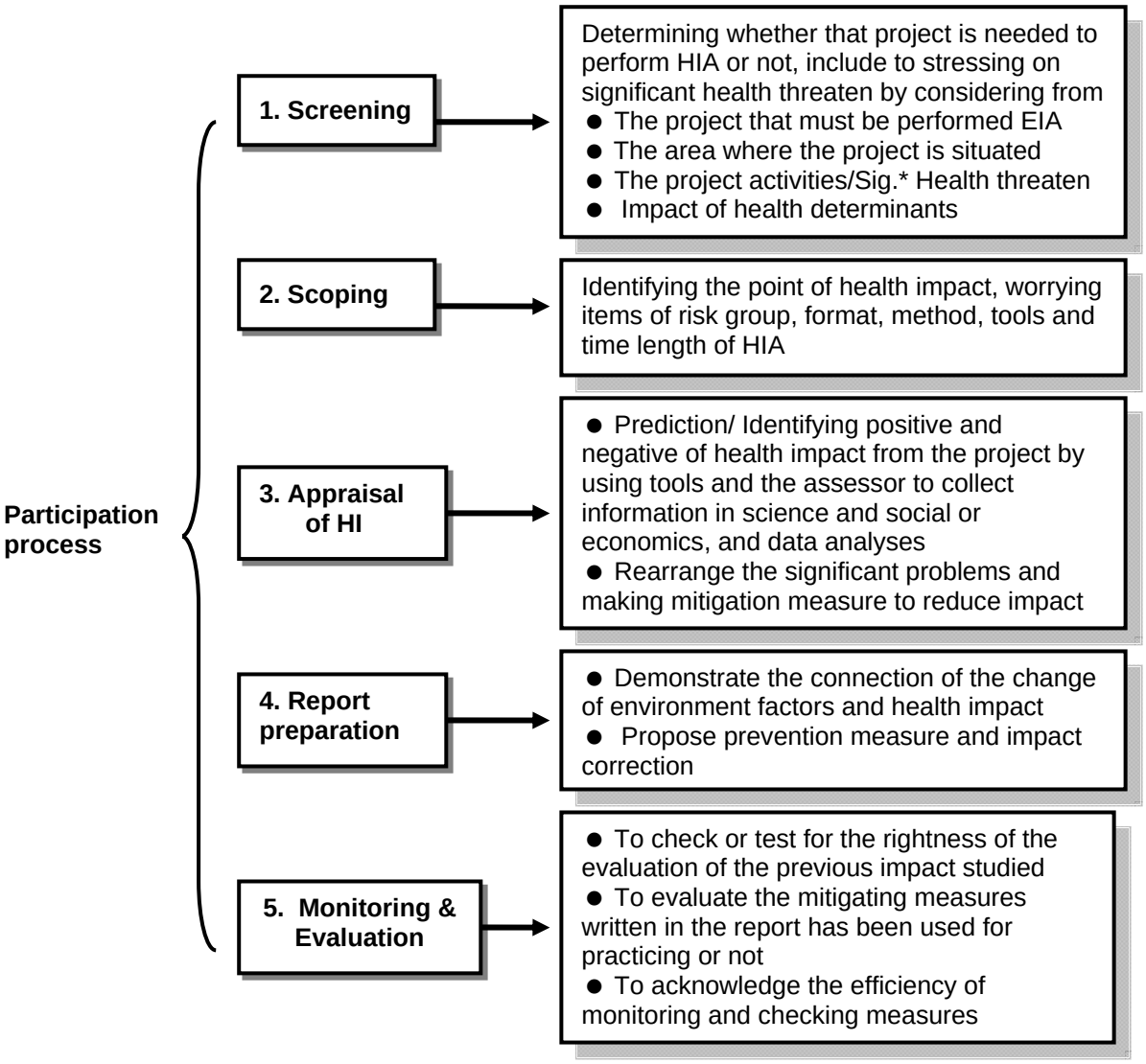


Figure 3-1 Steps of health impact assessment

* = Significance

3.1 Health screening issue (Screening)

At this stage is the step of determination whether those projects are required to perform report of environmental impact assessment (EIA) or not. If it is fallen into the scope of performing EIA, it is a must to conduct health impact assessment in parallel. The important principle used for determining for such a type and size of the project that needs to conduct EIA are to examine the process of activities or the project itself has any factors or threats to induce impact on the people health or not, that needs to study in details. The detail of study of project concerned comprises:

1) Principle and Reason, Objective and Aims of the Project

2) Explain engineering data of the project: As for example, project types, dam types, length and height of dam, capability of water collection, size of water surface area, characteristics of building structures, characteristics of irrigation type, competency of productivity, picture of cross section of dam of all dams of project, and etc.

3) Explain type and quantity of all materials used: Such as source of energy, water, materials used for construction including the explanation of waste management in brief

4) Explain about public utilities, public facilities and desired servicing: Such as electricity, water, waste management and road, and etc., together with a must to present the impact determinants that might be occurred to health (hazard identification).

5) Step of procedure of water resources development or project lifecycle: Such as pre-construction phase, construction phase, management phase/water collection phase. Of each phase may induce different kinds of impact to health. The project activities, i.e., transportation of materials and equipments, management of material and waste product, rock explosion and the danger that might be occurred (physical hazard) e.g. dust and noise, and etc.

6) Impact receivers or human exposure: Population residing in the project area and the project workers, all this, a special attention must be paid to or focused on the vulnerable groups such as the native or aborigine, children, pregnant woman, the elderly and individuals with health problem. Change of environmental condition or the increasing of chance of the community to expose to any factors that may contract health problem e.g. the communicable diseases or insect vector, and etc.

7) Possible effect: The possible physical aspect or the cause of illness, quality of life, and services in health and occupational health aspects

3.2 Scoping the study issue or Scoping

3.2.1 Objectives and Methodology of specifying the scope of the study

Specifying the scope or scoping of the study at this stage is the step to plan for studying the impact by determining the significant that influence the change in various aspects of health determinants such as environmental health determinant aspect, social aspect and, service of public facilities and public health aspects. All this, scoping of good study will make the results of

assessment more efficient, high effective and increase reliability. Specifying the scope of study has 4 main objectives as follows:

1) Judging of the factor(s) that ought to be studied, choice of project and the impact out come may be occurred

2) Rearrange significant detail for studying and/or deleting less important effects

3) Setup an appropriate scope of study by determining from the area where the impact might be occurred, risk group such as area to be studied, size of area to be covered, time length or period of study, or of which population group by examining from:

- *Detail of project Information data,* i.e., size and characteristics or type of water resources development project
- *Information of health determinants* to use as basic information in health impact assessment by showing of information at individual level, social community information level, information of public health service system, information of environmental health servicing aspect, information of environmental aspect in physical, chemical, biological, characteristics of environmental appearance, i.e., epidemic source of disease or intermediate host, and etc. **(ANNEX 1)**
- *Information of population health status* in the area **(ANNEX 1)**
- *The impact that use to occur* from the project of same characteristics in other areas **(ANNEX 1)**

4) Make an appropriate judgment in each of level of impact studied to what kind of impact that needs to study in broad or in-depth together with the scope setup in the manner of boundary of area and timeline of project to be studied. To scope for the area of study should be divided into catchment area or area of reservoir or flood area, construction area, irrigation area, resettlement area, and surrounding cantons around the project area. And to scope for project duration should be divided into pre-construction phase, construction phase and water collection phase/project operation phase.

All this, the existing information, possibility or convenience of searching or investigating for needed information, time duration and budget must be brought up together for determination or consideration.

Illustrative example of details of health impact issue and example of scoping boundary of the study are shown in **Table 3-1 and Table 3-2,** respectively.

3.2.2 Public hearing to scope the boundary of study (Public Scoping)

Comments and concerns of unpredictable consequences from the construction of dam project in the area by group of stakeholder, people and other sectors including participation in issues and guideline scoping in assessing health impact are very important in making complete assessment in most of all aspects of effects in health. All this, the acquisition of concerns of the people about water resources development project ought to follow the guidelines of the scoping of

health assessment by the public hearing (Public Scoping) as set by the Office of National Health Committee, 2552 as follows:

1) Must notice the public not less than 1 month through at least 3 channel of public media for the purpose of all interested public can be able to attend.

2) Must disclose all data of information, i.e., project details, procedure of production, raw material and pollutant emit from the project including guideline of health assessment in order to keep interested public to predetermine not less than 15 days before staging.

3) Staging for public must set up time duration to open chance for general public not less than 2 hours and not less than half of total time of staging the public scoping.

4) Post public scoping must provide an access for hearing continually not less than 15 days through at least 2 channels.

5) Preparation for sum up of public opinion report (summary report) including statement of explanation and present the framework or boundary and the guideline of health impact assessment for continuation the action of health impact assessment to point beyond.

Table 3-1 Example of health impact issue of water resources development (to be continued to 3-1.1)

Phase of Project	Activities causing health impact	Health threat identification	Configuring risk group impact acquired	Potential health / situational outcome
Pre-implementation phase		**Mental health**	Land expropriated people	Mental health problem, i.e., tension or strain
		Transmitted diseases	- Local people (existing disease before dam construction)	Helminthiasis
Construction phase	Dam and its component construction	**Transmitted diseases**	- Local people - New migrated group - Forest concerned occupational group - Construction workers - Irrigation Department workers (working in the area)	Insect vector-borne diseases, i.e., - Malaria - Dengue haemorrhagic fever - Elephantiasis - Encephalitis
			- Workers - Children - Group of people in the area	Water-borne diseases, e.g. - Typhoid - Acute diarrhoea - Cholera - Hepatitis A - Dysentery
			- People in the area - Workers	Sexual transmitted diseases (STDs), i.e., - Aids - Pseudo-gonorrhea, venereal diseases

Table 3-1.1 Example of health impact issue of water resources development (to be continued to 3-1.2)

Phase of Project	Activities causing health impact	Identify Health threat	Configuring risk group impact acquired	Potential health / situational outcome
Construction phase (conti.)	Dam and its component construction (cont.)	**Transmitted diseases** (conti.)	- People in the area - Construction workers	**Helminthiasis**, e.g., - Human schistosomiasis - Liver fluke infestation - Hook worm infestation - Strongyloides - Other medical important helminthiasis
		Non-transmitted diseases	- Construction workers - People living nearby road - Children	- Disease of respiratory system/Asthma (dust)
		Accident/Injuries	- Construction workers - People in the area	- Controversy or quarrel in the community and family - Illness/ Injuries from seismic activities - Injuries/Accident from work and transportation
		Nutritional condition	- Construction workers - People in the area	- Mal-protein and energy or inadequate of essential elements
		Mental health	- People in the area - Immigrated construction people - Land expropriated people	- Mental health problem, i.e., tension or strain, adaptation problem

Table 3-1.2 Example of health impact from water resources development issue (to be continued to 3-1.3)

Phase of Project	Activities causing health impact	Identify Health threat	Configuring risk group impact acquired	Potential health / situational outcome
Construction phase (conti.)	Dam and its component construction (cont.)	**Social health**	- Construction workers - People in the area	- Public health services - Labor residential sanitation
Water storing phase/ Operation phase	Water storing /Irrigation	**Transmitted diseases**	- People in the area - Local people - New immigrated in group - Forest related occupational group - Irrigation Department workers (working in the area)	Insect vector - borne diseases, i.e., - Malaria - Dengue haemorrhagic fever - Elephantiasis - Encephalitis
			- Children - People in the area	Water - borne diseases, e.g. - Leptospirosis - Acute diarrhoea - Dysentery - Hepatitis A - Cholera - Typhoid
			- Children - People in the area	1. Water - base helminthiasis, e.g., - Human schistosomiasis - Liver fluke infection 2. Soil transmitted helminthiasis, such as Hook worm infestation & Strongyloides

Table 3-1.3 Example of health impact from water resources development issue (the last part of Table 3.1)

Phase of Project	Activities causing health impact	Identify Health threat	Configuring risk group impact acquired	Potential health / situational outcome
Water storing phase/ Operation phase (cont.)	Water storing /Irrigation (cont.)	**Non-transmitted disease**	- Children - People in the area	- Chemical toxic from agricultural usage - Toxic from heavy metals
		Accident/Injuries	- People in the area	- drown - Violence controversy in community and family - Injuries from communications
		Nutritional condition	- Construction workers - People in the area	- Mal-protein, mal-carbohydrate or inadequate of essential elements
		Mental health **Social health condition**	- Construction worker and family - People in the area - Land expropriated people	- Mental health problem → Tension → Addicted drugs, Amphetamine, Alcohol - Adapting problem to dislocation of dwelling and workplace that might be a cause of mental health problem such as worrying, depress condition, and etc

∗ **Note:** All illustrated data in the table is only an example not for use in all kind of projects since the conditions of the area of each project are different.

Table 3-2 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.1)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Pre-implementation	**Mental health condition**	Level of tension or strain	- Land expropriated people - General population	- Construction area	- Use "Stress Assessment Form" of The Department of Mental Health as follow: 1. Land expropriated group: Collect data to cover in all aspects as much as can be done 2. People in general; Number of sample used follows the principle of statistic for descriptive research
Construction/Operation phase	**Mental health condition**	Level of tension or strain	- Land expropriated people - Migrated construction people (workers)	- New area of resettlement - Construction area	- Use "Stress Assessment Form" of the Department of Mental Health **Note:** All data collection used must be equal to same as of done during pre-implementation phase
	Malaria	**Mosquito vector:** Presence of principle mosquito vector	Anopheles mosquitoes - Principle vector - Secondary vector - Suspected vector	**Construction area** **-** Reservoir - Irrigation **Evacuated area** **Surrounding cantons**	**Mosquito vector:** - Survey and mapping the breeding place of mosquito vector - 1 year survey for mosquito species: Once a month 2 days at a point, 100 time of swift scooping for larvae collection and collect adult outdoor according to the procedure of Department of Disease Control

Table 3-2.1 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.2)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Malaria** (cont.)	**Health status:** - Number-Morbidity rate - Number-Mortality rate - Number of infected in the area **Risk behavior** - Dislocation - Principle - 2nd career - Self-protection	**People:** - Local people - New migrant - Forest occupational group - Construction workers - Irrigation Department workers	**Construction area:** **-** Reservoir - Irrigation **Evacuated area** **Surrounding cantons** (cont.)	**Health status:** - Secondary source, i.e., Hospital, Office Vector Borne Disease Control, Provincial Public Health Office (Report code No. 506) - Investigation of infection in the area (Report code No. 3) - 100% blood examination in the worker **Risk behavior** - Survey for factors enhancing (disease) infection, e.g., use mosquito net - Migration, principle-secondary career, self protection
	Dengue haemorrhagic fever **Chikungunya**	**Mosquito vector:** Presence of principle mosquito vector **Health status:** - Number-Morbidity rate	**Asian tiger mosquito (**Stripe mosquito) genus *Aedes* - Common house stripe mosquito - Garden stripe mosquito **People:** - Local group - New move in group	**Construction area:** **-** Reservoir - Irrigation **Evacuated area** **Surrounding cantons**	**Mosquito vector:** Secondary sources. i.e., Provincial Public Health Office, Hospital and District Public Health Office according to the criterion of Department of Disease Control - HI (House Index) - CI (Container Index) **Health status:** Secondary sources, e.g., Provincial Public Health Office, hospital **-** Factor supported infection survey form

Table 3-2.2 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.3)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Dengue haemorrhagic fever** **Chikungunya** (cont.)	**Health status:** (cont.) - Number-Mortality rate - Number of infected in the area **Risk behavior** - Principle-2nd career - Self-protection	**People:** (cont.) - Construction workers - Irrigation Department workers - Children - Pupil	**Construction area:** Same as of above	**Health status** (cont.)**:** i.e., geographical, migration, occupation, behavior **Risk behavior** **-** Survey for using mosquito net during day time - managing around residential area free from mosquito breeding place
	Elephantiasis	**Mosquito vector**	**Tiger mosquito**	**Construction area:** **-** Reservoir - Irrigation **Evacuated area** **Surrounding cantons**	**Mosquito vector:** - Survey and mapping the breeding place of mosquito vector - 1 year survey for mosquito species: Once a month 2 days at a point, 100 scooping stabs for larvae collection and collect adult outdoor according to the practice regulated by Department of Disease Control

Table 3-2.3 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.4)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Elephantiasis** (Cont.)	**Mosquito vector** (cont.) **Health status:** - Number- Morbidity rate - No. of infected with swollen organ **Risk behavior**	**Tiger mosquito** (cont.) **People:** - Local people - New migrant group - Forest occupation - Construction worker - Irrigation Department worker	**Construction area:** **-** Reservoir - Irrigation **Resettlement area** **Surrounding cantons** (cont.)	**Health status:** - Secondary source, i.e., Hospital, Office Vector Borne Disease Control, Provincial Public Health Office (Report code No. 506) - Investigation of infection in the area - Worker blood examination 100% **Risk behavior:** - Survey for factors enhancing infection, e.g., mosquito net usage, migration, principle-secondary career, self protection
	Human schistosomiasis (*Schistosoma mekongi* infection)	**Snail, man and animal reservoir** **Snail:** - Existing of snail intermediate host in area - Existing of natural infected snail	**Triculine snail/ Related taxa:** - Survey for *Neotricula aperta*, α, β and/or γ races & other *Tricula* spp. that might be found to exist in the project area	**Project/related areas:** Water source in the - Proposed reservoir area - Dam site - Irrigation area - Evacuated area - Surrounding area	**Snail:** - Survey for snail intermediate host such as *Neotricula aperta* and related taxa. Survey should be conducted in the late of dry season because it is not only having more chance of getting infected snail from the nature but also much easier to gain an access to its micro-niches to obtain more substrates. They prefer to live in slow running current by clinging under the substrate near shore of the river and/or around small island or in the islet of the main river and its tributaries.

Table 3-2.4 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.5)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Human schistosomiasis** (Cont.)	**Snail:** (Cont.) Same as of above	**Triculine snail/ Related taxa:** (Cont.) Same as of above	**Project/related areas** (Cont.) Same as of above	**Snail:** (cont.) The favorite site of attachment is on the surface of small rock, in the socket of twigs, under the dead leaves including to the root of water plant and stem of water weeds (not in mud). The collection can easily be done by hand picking for the substrates. To separate the snails from the substrate with harmless is very easy by letting substrate with snails dry in air for not more than one minute) to sensitize snail to close its aperture prior to free the detached snails by dipping with gentle swirling in the water in the container. Population density study of this snail is quite difficult but normally can be done by counting number of snail/foot^2 or square meter. All collected snails must be separated and classified prior checking for natural infection by shedding & crushing techniques in the field before bring the rest of them back to continuing study in the laboratory. The study in the laboratory comprises cultivation for

Table 3-2.5 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.6)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Human schistosomiasis** (Cont.)	**Snail:** (Cont.) Same as of above **Man:** **Health status** - Number of Infected case, morbidity rate **Health risk behavior:** - Water contact - Water related occupation: Fishing **Animal reservoir host:** - Number of infected case, morbidity rate	**Triculine snail/ Related taxa:** (Cont.) Same as of above **Man:** - Local people - Returned local worker from endemic area - Immigrated construction workers and family - Irrigation Department worker - Children, pupil **Animals:** - Domestic cattle, dog cat and wild rat found in the study area	**Project/related areas** (Cont.) Same as of above **Study site:** **-** Construction area or dam site - Resettlement - Irrigation - Related area **Study site:** **-** Construction area or dam site - Resettlement - Related area	**Snail:** (cont.) rechecking of natural infection, susceptibility test, confirm for correct snail identification and/or preservation for future evidence or to keep as typed specimens. **Fecal examination:** - using Formalin-Ether-Concentration - Sample size; using standard statistical model due to study design **Health risk behavior:** Use Health Risk Behavior Supported Helminthic Infection Questionnaire of Department of Disease Control to interview group of health risk behavior in the study area **Cattle:** Collect dung in the morning from individual fasten overnight **Dog and cat:** Collect feces direct from anus **Wild rat:** Collect by trapping

Table 3-2.6 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.7)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Human schistosomiasis** (Cont.)	**Animal reservoir host** (Cont.) - Presence of schistosome egg in dung of cattle or in feces of dog and cat - Presence of miracidium in the hatching of cattle dung - Presence of adult worm, miracidium and/or egg in blood and/or in feces of wild rat	**Animals:** Same as of above	**Project/related areas** (Cont.) Same as of above	**Wild rat:** (cont.) - The number of sample used for study is usually not specified since the number of sample obtained from trapping varied according to the abundance or the population density of wild rat in each area. Thus, in general alternative way used is the numbers of trap and time (no. of night) as for example 100 traps per night for 2 nights by experience trapping men regardless the number obtained. **Fecal examination**: For presence of eggs In all kind excreta (cattle dung, and dog and cat feces). - using Formalin-Ether-Concentration - Sample size; Total of 400 sample of all kinds of mention animal reservoir hosts **Hatching:** For presence of miracidium - Perform only in selected case of cattle and from the feces of wild rat **Blood perfusion:** For presence of adult worm in the portal vein only in wild rat

Table 3-2.7 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.8)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Human liver fluke infection or opisthorchiasis** (excludes from the study of HIA in the southern part Thailand since the infection is very low only 0.01%)	**Snail, Fish and Man** **Snail:** - Presence of snail intermediate host genus *Bithynia* spp. e.g. *B. funiculata, B. goniomphalos* and/or *B. siamensis* Depends on geographical location - Existing of natural infected snail	**Bithynid snail:** - *Bithynia funiculata* - *B. goniomphalos* - *B. siamensis* Depends on the species found in the area study - Appropriate number of sample in total use is about 6,000 snails since the infection rate of this parasite in the nature is very low, but just in case of very low density of snail population the number used is depended on the number obtained from high effort of collection but must be explained and discussed in detail.	**Water sources in the project and related areas:** - Rice field near village and communities near impact area and / or near the area that will turn to be reservoir - Construction area - Resettlement area - Irrigation area	**Snail:** Survey for snail population density in or nearby project area can be performed by sieving, digging, man-hour and/or hand picking techniques depending on an initial noticeable of snail dispersion and location or site of study. To report for population density is also depended on size of the study area, location and method used such as the study in rice field during dry season, the digging should be applied and the density of snail is number/square foot same as of hand picking. However, details must be discussed and explained. The collected snails must be separated and correctly identified prior individual checking for natural infection by using shedding and/or crushing techniques. Part of snail sample must be preserved and kept as typed specimen for future evidence and study. **Note:** Use standard methodology of Department of Disease Control

Table 3-2.8 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.9)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Human liver fluke infection or opisthorchiasis** (excluded from the study of HIA in the southern part Thailand since the infection is very low only 0.01%) cont.	**Snail, Fish and Man:** cont. **Fish:** **-** Presence of fish 2nd intermediate host - Presence of natural infected fish	**Small and large scale fish:** - Cyprinoid fish and related taxa - Appropriate number of sample in total use for study is about 400 fish. Just in case of very low density, the number used may be varied according to the number obtained from the collection but the reason must be explained and discussed suit to the result of related study and affordability used during investigation	**Water sources in the project and related areas:** - Rice field near village and communities near impact area and / or near the area that will turn to be reservoir - Construction area - Resettlement area - Irrigation area	**Fish:** Fish can be collected from natural water sources such as swamp, pond, water passage, canal and etc in side the impact area. Fish sample used for study must be separated and correctly identified prior to individual checking for natural infection by crushing to observe for the presence of metacercariae of liver fluke under stereo-microscope. The best part of fish used for crushing are the flesh at caudal fins, tail fins and pectoral fins. For low infection digesting of whole body of an individual or mix of the same species of fish is recommended by using enzyme pepsin A. Preserved of doubt specimens must be well preserved and sent to confirm for correct identification by fish expert at Fishery Department. Preserved of doubt and /or correct identified fish must be kept as type specimen for future evidence or study. **Note:** Cyprinoid fish used for examination if obtained from the same area of snail collection is high favorable.

Table 3-2.9 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.10)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Human liver fluke infection or opisthorchiasis** (exclude from the study of HIA in the southern part Thailand since the infection is very low only 0.01%) cont.	**Man:** **Health status:** - Number of Infected case, morbidity rate **Health risk behavior:** - Eating raw or uncooked fish	**Man:** **-** People in general **-** Construction worker from the North, Northeast provinces and some part of the Central province such as Saraburi, Prachin Buri and Lop Buri and etc.	- Construction area - Around reservoir and related area - Resettlement - Irrigation	**Health status: Fecal examination:** **-** Modified Cato-Technique for screening **-** Formalin Ether Concentration Technique **Health risk behavior:** Use Health Risk Behavior Supported Helminthic Infection Questionnaire of Department of Disease Control to interview group of health risk behavior in the study area
	Human lung fluke infection or Paragonimiasis: (Since snail 1st I.H. is not known, thus the study is only restricted to crab the 2nd I.H. and human infection)	**Crab and man** **Crab:** **-** Infected crab	**Crab:** - Freshwater crab - Mountain crab - Waterfalls crab - Stream Crab - Rice field crab - Creek crab **Note:** The local name of the same crab from these sites may different from place to place)	**Water sources in the project and related areas in:** - Construction - Resettlement - Irrigation (includes stream, waterfalls, stream, creek, rice field and mountainous area)	**Crab collection:** Hand picking or trapping is used for crab collection. The collection should be done when they are an individual abundant during early rainy or early winter seasons otherwise we have to dig and catch them out from the hole during dry season. **Crab examination:** Follows standard method of The Department of Disease Control by crushing and Pepsin A digestion techniques

Table 3-2.11 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.12)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Human lung fluke infection or Paragonimiasis:** (Since snail 1st I.H. is not known, thus the study is only restricted to crab the 2nd I.H. and human infection)	**Man:** **Health status** - Number of infected case (Presence of egg in sputum) - Morbidity rate **Health risk behavior:** - Eating raw crab	**Man:** **-** People in general **-** Construction worker (Usually perform in chronic coughing cases exclude aids and tuberculosis groups to prevent disease transmission)	**Project and related areas:** - Where suspected case could be found	**Sputum examination:** Simple smear of sputum and stain with iodine solution prior examination under microscope. **Health risk behavior:** Follows instruction by using Health Risk Behavior Supported Helminthic Infection Questionnaire of Department of Disease Control to interview group of health risk behavior in the study area
	Medium and small intestinal flukes of human* (Usually, study is restricted only to the snail of 1st and 2nd I.H.)	**Snail:** - Presence of snail intermediate host - Existing of natural infected snail	**Snail:** - *Bithynia* spp. - *Lymneae* spp. - *Filopaludina* spp. - *Indoplanorbis exustus* - *Gyrualus* spp. - *Pila* spp.	**Water sources in the project and related areas:** - Construction - Resettlement - Irrigation area - Related impact area	. Others follow the Method of collection: Select appropriate method from listed above. Besides that scooping technique is suitable to use for Filopaludina snail collection in deep water source above instruction.

Notes: * **=** The study is usually restricted only to the snail of 1st and 2nd I.H. since other information about health status and health risk behavior can be timely obtained from opisthorchiasis study.

- In order to get precise results of study involving the natural infection of parasite in snail and fish, the collection of these animals during the late of the dry through the early of rainy seasons is strongly recommended.

Table 3-2.11 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.12)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Soil transmitted helminthiasis:** **- Hook worm** **- Ascariasis** **- Whipworm** **- Strongyloides** is restricted only in the South)	**Health status** - Morbidity of each of specify name in man **Health risk behavior:** - Bear foot - Sanitation practice	People in general Construction worker	**Study site:** **-** Construction area or dam site - Resettlement - Irrigation - Related area	**Fecal examination:** Actually the results can be timely obtained from liver fluke and schistosome examination. **Culturing method:** By using “Agar Plate Culture” for accurate confirmation of *Strongyloides stercoralis.* **Health risk behavior:** Using Health Risk Behavior Supported Helminthic Infection Questionnaire of Department of Disease Control to interview group of health risk behavior in the study area
	Meningitis	**Health status** - Incidence of meningitis			**Information:** Secondary information of meningitis from health center; Report form 506
	Sexual transmitted disease	**Health status** - Incidence of sexual transmitted disease	People in general Construction worker	**Study site:** **-** Construction area or dam site - Resettlement - Irrigation - Related area	**Information:** Secondary information of sexual illness from health center

Table 3-2.13 Example of scoping of health impact assessment from water resources development project (to be continued to 3-2.14)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Leptospirosis**	**Health status** - Incidence of Leptospirosis	People in general	**Study site:** **-** Construction area or dam site - Resettlement - Irrigation - Related area	**Information:** Secondary information of Leptospirosis from health center; Report form 506
	Mental Health	Level of strain	- All people who receive the impact includes adult and children - Construction worker	Reallocating of settlement area	**Information:** Obtain information through interview follows instruction by using “Stress Assessment Form” for adult and SDQ assessment form in children
	Chemical usage in agriculture	- Disease from chemical toxic - Blood cholinesterase level	- Children - People in general	**Study site:** **-** Construction area - Reservoir - Irrigation	**Information:** Uses secondary information of illness from chemical toxic Report form 506/2 Survey form of chemical usage Blood examination
	Accidence	Statistic of accident	- Construction worker - People in general	**Study site:** **-** Construction area - Reservoir - Irrigation	**Information:** Obtains from secondary report of accidental data

Table 3-2.14 Example of scoping of health impact assessment from water resources development project (last part of Table 3.2)

Project Phase	Study issue	Indicators	Study population	Study area	Methods/Tool used for data collection
Construction/Operation phase (cont.)	**Sanitation/ Environmental health**	**Health status** - Diarrhoea - Acute diarrhoea - Cholera - Typhoid - Dysentery - Food poisoning **Health risk behavior**	- Construction worker - People in general	**Study site:** **-** Construction area - Reservoir - Irrigation	**Information:** **-** Secondary data; Report 506 - Sanitation survey form **Information:** Health behavior survey form
	Nutritional status	- Mal-protein disease and energy (W/A, HA, WH) - Anemia - Food source - Other involve	- Preschool children - School age children	**Study site:** **-** Construction area - Reservoir - Irrigation **Resettlement**	- Mal-protein disease and energy: Secondary source from health centre (weight, height and age) - Anemia: Secondary source from hospital, health centre (Hematocrit/Hemoglobin) - Food source survey form
	Sufficiency of health personnel				

3.3 Health impact assessment (Appraisal)

At this stage is the forecasting/stating of health affected from project in both positive and negative impacts, indicating severity level of impact, sequencing significant profile of potential problems and setting measures to mitigate the impact resulted from water resources development project. All this, the assessor(s) must elaborate and rationale the characteristics of anticipated health impact that might be occurred from water resources development project at each point of predicted effect in health by using data of health status for analyzing, synthesizing to compare with national or provincial benchmark. However, in some point or aspect of issue, standard of World Health Organization (WHO) may be applied to assist the determination.

Forecasting for occurrence of effect in health from water resources development project, the assessor must determine for chance and virulence on health at each point or issue. In the part of determining for chance of being occurred can be examined from 3 factors such as 1) finding disease reservoir or vector in the area 2) the activities of the project favors infection 3) having risk group(s) in project area or exposure sensitive group, i.e., determination for chance of malaria infection are as follows:

1. Topographical location risk to get disease transmitted by insect

2. Occupation risk to get infection, e.g. forest gathering, entering into risk area

3. Risk behavior, such as do not use mosquito net during asleep, eating imoper cooked food and walk with bare foot (discalced)

Analyses of severity of consequences, the assessor must analyze the level of impact severity occurring in worker or people in the community who may receive impact from the water development project. The level of health impact determination may be done under hypothesis of the worsen health impact. All this, conditions that may be used for analyzing the level of health impact in each point are illustrated in Table 3-3 as follows:

Table 3-3 Illustrate the criterion used for analyzing of severity of consequences

- **Insect transmitted disease**

Point of Issue	Details	Indicators
Malaria	**Morbidity/Mortality**	
	- Number - Morbidity rate	**Low:** less than previous year
		Moderate: less than previous year and not higher than median
		High: higher than median for 5 years
	- Number - Mortality rate	**Higher:** Fetal
Dengue haemorrhagic fever	**Morbidity/Mortality**	
	- Number - Morbidity rate	**Low** less than previous year
		Moderate less than previous year and not higher than median
		High higher than median for 5 years
	- Number - Mortality rate	**Higher** Fetal and HI&C $\leq$ 10
	Mosquito vector	
	- House Index	
	- Container Index	
Elephantiasis	**Morbidity/Mortality**	
	- Number - Morbidity rate	**Low** lesser than previous year
		Moderate lesser than previous year and found infected case with big swollen organ
	- Number - Mortality rate	**High-Higher** presence of infection in area

- **Health status**

Health status	**-** Level of stress - SDQ	Interpretation Suanprung Stress Test - 20 (SPST 20): Total score not more 100 marks divides into 4 levels: Marks 0-23 less stress Marks 24-41 moderate stress Marks 42-61 high stress Marks 62 and up severe stress

Interpretation of assessment form:

Stress test form

1. Interpretation of stress level

- Marks 0-23: means low level of stress
- Marks 24-41: means moderate level of stress. It can be occurred in every day life, the stress at this level will not cause any harm or be non-beneficial to way of life. The stress can be abated by many ways such as by performing some activities to enhancing power or strength e.g. exercising, sporting and, acting amusement and enjoyable, i.e., listen or play music, reading book, doing hobby and/or chatting with close person.
- Marks 42-61: Means high level of stress: The causes are from stimulus from circumstances around to induce anxiety, fear of opposing or be within some problem condition that can not be managed. The emotional adaptation is rather difficult resulted in bad effect on daily life and sickness such as hypertension, wound in stomach. At this level, the stress must be urgently reduced by simple way but very effective e.g. breathing exercise to relax, chatting and try to release the stress by telling trusted person, try to detect or look out for the cause or problem of stress and seek way to cure it. If problem stills remain and can not be self-managed, consultation with serviced mentor of related mental health units (public health) is recommended.
- Marks 62 and up: Means severe level of stress. It is a continuation of high stress or you are facing crisis in life such as chronic severe sickness, disable and/or losing of lover, asset or beloved things. The stress at this level will affect physical illness and mental health. Life is unhappy and woolgathering or absentmindedness, decision making is not good and can not withhold temper. Patient needs to get help from serviced mentor of various related mental heath units in urgent.

2. Recommendation to continue the attention: In case of high and severe levels of stress

2.1 Ought to use screening form/Stress test form 2 questions and 9 questions and self-harm though assessment form of 8 questions of Department of Mental Health. If result of test is positive, case needs to be sent to community hospital to continue diagnosis and treatment.

2.2 Continuation history questioning to get more details or information and if the physical symptom is present or persist e.g. headache, heart tremble, chest tightness, anorexia, sleepless and etc. to disturb normal practice of daily life, case needs to be transferred to community hospital to continue diagnosis and treatment.

● **Nutritional Status**

Point of Issue	Indicator	Judgment Criteria	Interpretation
- Mal-protein and energy Graph showing criterion reference to children growth Weight compare with age/ Height compare with age/ Weight compare with age/ Weight compare with height (Nutrition Department)	Weight compare with age Height compare with age Weight compare with age	< 2SD Under weight < 2SD Short < 2SD Thin	- Mal-nutrition in broad view: chronic and acute - Chronic mal-nutrition - Acute mal-nutrition
- Anemia disease Level of Hematocrit/Hemoglobin	**Age group/Sex**	**Hemoglobin l(g/dl)**	**Hematocrit (%)**
	Children		
	6 m - 5 years	< 11.0	< 33
	5 - 11 years	< 11.5	< 34
	12 - 13 years	< 12.0	< 36
	Non pregnant woman	< 12.0	< 33
	Pregnant woman	< 11.0	< 33
	Male	< 13.0	< 39

● **Leptospirosis**

Point of Issue	Details	Indicator(s)
Leptospirosis		Morbidity rate 3.31/100,000 population (National level) Mortality rate 0.03/100,000 population (National level)

● **Toxic from chemical pesticide**

Point of Issue	Details	Indicator(s)
Pesticide chemical toxic		Morbidity rate from pesticide chemical toxic 1.68/100,000 population (National level)

● **Helminthiasis**

<table>
<tr><th>Point of issue</th><th colspan="2">Indicators</th><th>Intervention*</th></tr>
<tr><td rowspan="5">Liver fluke infection</td><td colspan="2">Morbidity (Prevalence) rate
Severity: Egg/gram of feces (EPG)</td><td rowspan="11">Level of risk management
Level 1: Prevalence ＞ 10%
Treats according species finding
Level 2: Prevalence ＞30 - 50%
Treats according species finding
Level 3: Prevalence ＞ 50%
Recheck fecal exam. from one person/house, if positive finding, treats in all of housing member</td></tr>
<tr><td>Severity level</td><td>EPG</td></tr>
<tr><td>Low</td><td>＜ 1 - 999</td></tr>
<tr><td>Moderate</td><td>1,000 - 9,999</td></tr>
<tr><td>High
Very high</td><td>10,000 - 29,999
＞ 29,999</td></tr>
<tr><td rowspan="6">Hookworm infection</td><td colspan="2">Morbidity
Severity: Egg/gram of feces (EPG)</td></tr>
<tr><td>Severity level</td><td>EPG</td></tr>
<tr><td>Low</td><td>＜ 1 - 999</td></tr>
<tr><td>Moderate</td><td>2,000 - 7,000</td></tr>
<tr><td>High</td><td>＞ 29,999</td></tr>
<tr><td colspan="2">Severity: Worm burden</td></tr>
<tr><td>Severity level</td><td>No. of adult worm</td></tr>
<tr><td>Low</td><td>1 - 50</td></tr>
<tr><td>Moderate</td><td>51 - 200</td></tr>
<tr><td>High</td><td>＞ 200</td></tr>
<tr><td>Human schistosomiasis</td><td colspan="3">No information available</td></tr>
</table>

3.4 Guideline preparation for prevention and mitigation measure of health impact

In significant sequencing level of effect in health if the effect is encountered of very high, high or moderate risk it is necessarily to have measure or activity to prevent or mitigate risk on health that might affect to the worker or risk group of population residing in the area is to make risk down to the least acceptable level including the enhanced measure of health.

3.4.1 Measure preparation for prevention and mitigation health impact

The prevention and mitigation measures of health impact is the control of bad result and pollution emitted from operational activities including the reduction of quantity

and chance of contamination in which it can be prevented from the point source, pathway of contact and the impact receivers as follows:

- **The point source:** Prevention of impact from the point source is considered to be main principal of preventing effect on health especially in the angle of public health and environmental health significant aspects. Most of significant impacts derive from water resources development project is usually occurred during construction phase often the impact from transporting of construction materials to causing dust spread and noise to disturb people residing along the trail of communication. One measure is to make well cover of transported materials in order prevent dust spread from truck including water spraying along the track of transportation. Besides this there is noise and seismic disturbance from rock explosion, thus it need to have preventive measure e.g. setup time schedule for rock explosion and advanced warning, using green technology, waste quantitative reduction, use material to cover machine to reduce noise disturbance, avoiding nocturnal activities that produced noise during construction, and etc.
- **Pathway of contact, i.e.,** fencing to set boundary line of construction site, planting tree line to fix bumper zone and spraying of water to prevent dust spread from transportation, and etc.
- **Impact receiver, i.e.,** uses specific tool for personal protection or an individual self protection and safety measure for life and asset or property, and etc.

All this, the procedure or technical used for preventing and mitigating health impact must follow an acceptable standard and in line with specify of related law.

3.4.2 Health promotion measure

Usage of preventing and mitigating health impact alone is sometime not sufficient hence it is necessary to have health promotion measure combined. Standard of health promotion of important measure is to promoting correct health behavior, reinforcing the strength of risk group population by training procedure of impact prevention or effect in health to them, strengthening the participatory of population to follow up public relation activity, knowledge providing, data of health examination, environmental surveillance data and etc.

3.4.3 Impact compensation measure

Compensation measure ought to be setup for social, community and/or individuals that might be lost of their occupation, income and/or land for earning their living as the result of development project such as the establishment of funds to recompense in health aspect, providing funds to support public health service aspect or providing educational scholarship. Besides giving money for direct recompense, measure of community enhancement e.g. occupational promotion,

special training, managing of educational touring or increasing community green area is necessary.

Considering items used for health impact mitigating measure preparation

1. Changing of project location
2. Changing of project design
3. Changing of project management
4. Having of environmental management measure
5. Enhancing the strength of health service such as health examination, providing knowledge involving the prevention of health impact
6. Organizing the systematic procedure of follow up and health impact surveillance
7. Restoring damages and providing recompense and compensation

3.4.4 Emergency Supported plan

Incidence of unforeseen emergency might be occurred and needed to be brought up for cautiously consideration and build up supported plan, i.e., in case of the occurring of various natural disasters, in case of fire and accidence or obstructions. The proposal of any measures used for each of these occasions the accepted point of involved people, recommended measures receiving from various sectors, participation of stakeholder, difficulty/easement of management, worthwhile of capital investment, covering to all risk group in both physical socio-economics and long term follow up, operation plan, budget or expenditure to support in case of emergency or in case of suspiciousness people's health must all be brought up for consideration. The format of presentation of mitigation measure of health impact ought to be well elaborated by showing the determination in each of separated project phase by includes pre-implementation phase, construction phase and operation phase in the following details as shown in **Table 3-4** comprising the following points or issues:

1. Health specifying factors / impact or effect
2. Control measure and correction of heath impact
3. Health enhancement measure / compensation or recompense
4. Area of implementation
5. Duration of implementation or frequencies
6. The responsible person/agencies

Table 3-4 Illustration of public health operational plan (Health impact mitigation measure) (cont. to 3-4.1)

Project phase	Impact/Effect	Prevention measure and health impact correction	Health enhancement	Implement area	Duration	Responsible person/Unit
Pre-implementation	Mental health status	- Producing media for public relation - Constructing of understandable - Compensation /Recompense - Land expropriation		Project site area	Pre-implementation	Project owner and local unit cooperation
Construction phase	- Water transmitted diseases and insect vectors - Malaria - Dengue hemorrhagic fever - Helminthiasis	- Setup prevention system for Water transmitted diseases and insect vectors - Destroy mosquito breeding place - Investigate and destroy the disease transmission site	- Health personnel training - population training about knowledge of sanitation and prevention of transmitting disease - Producing media for public relation campaign	Dam and surrounding area	Throughout the construction period	Project owner and local unit cooperation

Table 3-4.1 Illustration of public health operational plan (Health impact mitigation measure) (cont. to 3-4.2)

Project phase	Impact/Effect	Prevention measure and health impact correction	Measure of health enhancement	Implement area	Duration	Responsible Person/Unit
Construction phase (cont.)	Sexual transmitted disease	Establish center service, preventive tools e.g. condoms	- population training about knowledge disease, condom usage - Health personnel training in public health - Preparation of medium, manual, knowledge providing to people and worker	Dam and surrounding area	Throughout the construction period	Project owner and local unit cooperation Project owner
	Annoying form - Dusting - Explosive noise	- Establish complaint centre - Explaining and public relation of the project's impact and control measure and correction - Provide water truck to prevent dusting - Announcing of fixed explosive time	- Training and providing knowledge to people	Dam and surrounding area	Throughout the construction period	Project owner

Table 3-4.2 Illustration of public health operational plan (Health impact mitigation measure) (cont. to 3-4.3)

Project phase	Impact/Effect	Prevention measure and health impact correction	Measure of health enhancement	Implement area	Duration	Responsible Person/Unit
Construction phase (cont.)	- Working Accident	- Worker health examination - Perform the practice follow through preventive measure restrictedly - Provides first aid kit set, first aid room - Safety personnel Appointment - Install traffic signal plate - Specify the construction line	- Organize knowledge training involving safety during working period to the worker - knowledge training about sexual relation and prevention	Dam construction area	Every 6 months	Project owner
	- Addicted drug	- Urine examination for residue of addicted drugs	- Enhancing physical exercise - organize drugs opposing campaign activities - organize sport activities - Knowledge training	Dam construction area	Throughout the construction period	Project owner

Table 3-4.3 Illustration of public health operational plan (Health impact mitigation measure) (last portion of Table 3-4)

Project phase	Impact/Effect	Prevention measure and health impact correction	Measure of health enhancement	Implement area	Duration	Responsible Person/Unit
Construction phase (cont.)	Water and food borne diseases	- provides hygienic shelter and dwelling for worker - Provide food service/ hygienic cafeteria for worker			Throughout the construction period	Project owner
Water collection / operation phase	Water transmitted diseases and insect vectors - Malaria - Dengue hemorrhagic fever - Helminthiasis - water and food transmitted disease - Epidemic of respiratory disease - Skin disease	- Setup surveillance system for water and vector transmitted diseases - Destroy mosquito breeding place and vectors - Investigate and destroy the disease transmission site	- Health personnel training in public health - Training for the knowledge of disease prevention to the population - Preparation of medium for public relation campaign	Dam and surrounding area	Every 6 months - 1 year	Project owner and local unit cooperation
	Accidence/drown	- Establish rescue unit	- Knowledge training to the population	Dam and surrounding area	Every 1 year	Project owner and local unit cooperation

3.5 Guideline preparation for monitoring and follow up measure

Normally, monitoring and follow up of health impacts ought to setup plan of management and follow up health impact report and health determinants continuously for 3-6 months or 1 year through out of at least for 5 years or until the end of project compose of:

- Monitoring and follow up action plan during construction

- Monitoring and follow up action plan during project operation

All this, monitoring and follow up measures ought to be done along with the prevention and mitigation measures of health impact in order to evaluate whether the written measure of prevention and mitigation of health impact in the report has been brought up to practice or not. Beyond this point is the purpose of following up the monitoring plan of prevention and mitigation measures of health impact and health status of the people in the area can also be timely acknowledged.

For the follow up the result of health impact the participation and the cooperation of the project owner, population risk group in the area, expert, educational institute and public health unit in the area are necessarily needed to be integrated.

3.5.1 Index or indicator used for following up result of health impact

Important types of variables or indicators used in the following up effect in health are:

1) Health determinants or health threatened: To get correct informative of these may follow the change of environmental factors, economics, social or health threatened matters, i.e., examining the surveillance of pollution in soil, drinking water and water supply, food, noise and etc.

2) Health status or result of effect on health issue: This is the monitoring for the change of health status of community in relation to health determination or health threatened such as the surveillance of health ill from disease of respiratory system such as in the case of project releasing air pollution in which the follow up for the result of examination on health status or health issue is necessary and needed a long term of follow up since majority of result of health impact are from continuity accumulation of impact prior showing the symptoms or giving a clear result.

To fixing variable or indicator to follow up monitoring of effect on health ought to link with issue of health determinant of which is the cause of health threatened as previously mentioned in the scoping and appraisal stage of health impact study in connection with the mitigation measure of health impact to be mentioned in the report illustrating in the **Table 3-5** as follows:

Table 3-5 Illustrative plan of following up and monitoring of health impact (To be cont. to Table 3-5.1)

Project phase	Activity/ Impact	Risk group	Area	Indicators		Period/ Duration	Methodology/ Tools	Responsible person
				Environmental	Health			
Construction phase	Noise	- Construction worker	- Construction - Community locating along transportation path	Out door noise standard	Hearing level	Every 6 month - 1 year	Due to standard/ Specify by law	Environmental unit / Public health unit
	Dust	- Construction worker - Population in community - Allergic group/ Respiratory disease	- Construction - Community residing along transportation path	Quantity of suspended dust in air	- Morbidity of Respiratory disease - Lung capability	- Early stage of construction; every month - Every 6 month - 1 year	Due to standard/ Specify by law	Environmental unit / Public health unit
	Nutritional status	- Pre-school children - School children	- Project surrounding area		- Percent of child weight nutrition status low/ Over than standard	- Every 6 month - 1 year		Environmental unit / Public health unit
	Sexual transmitted disease (HIV, syphilis, gonorrhea)	- Construction worker - Population in community - Reproductive age group	- Construction area		- Morbidity of Sexual relation disease	- Every 6 month - 1 year	Secondary data from health unit in the area	Public health unit

Table 3-5.1 Illustrative plans of following up and monitoring of health impact (To be cont. to Table 3-5.2)

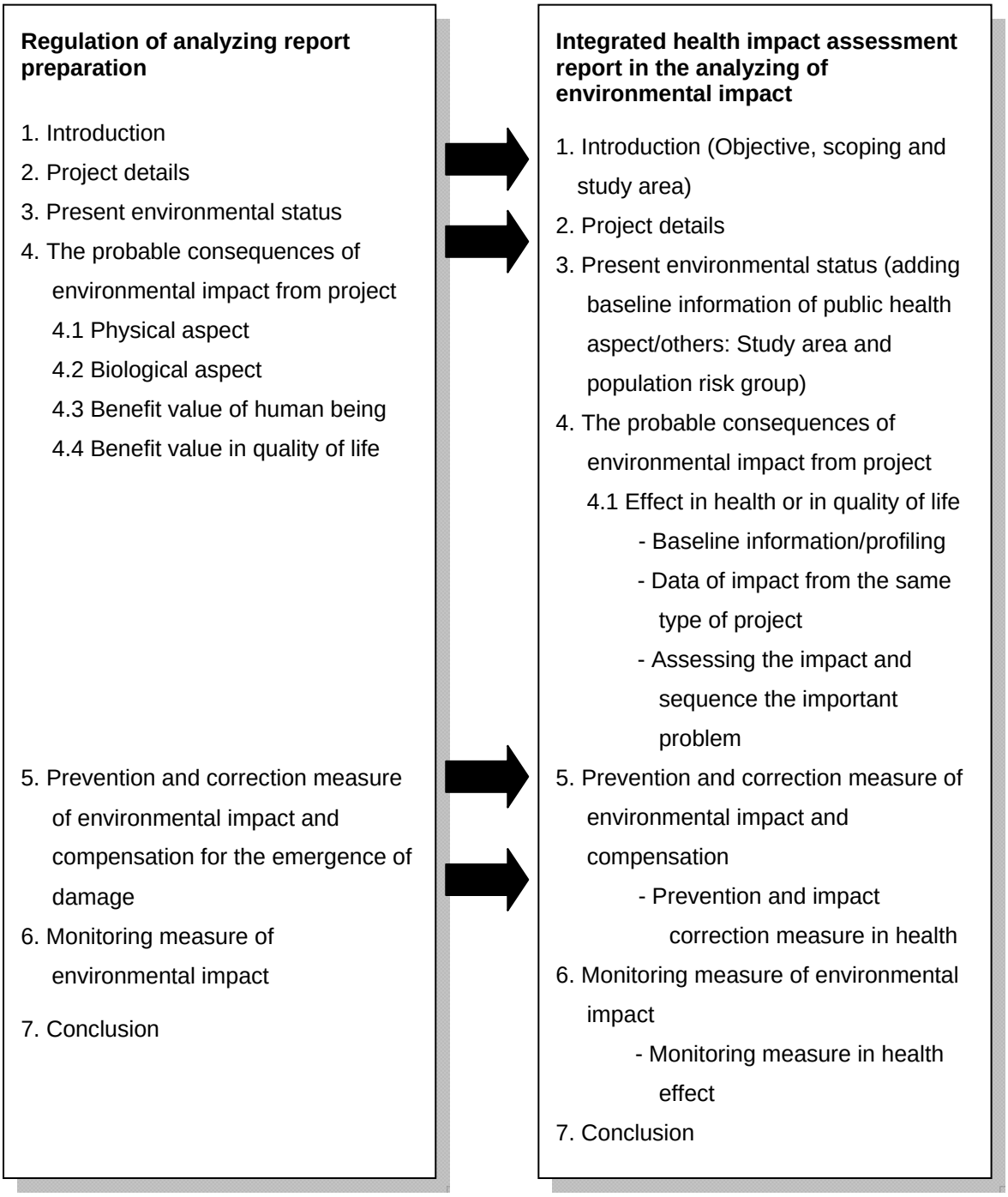
Project phase	Activity/ Impact	Risk group	Area	Indicators		Period/ Duration	Methodology/ Tools	Responsible person
				Environmental	Health			
Construction phase (cont.)	Disease of alimentary system and water	- Construction worker - Population in community	- Construction area		- Morbidity of disease of alimentary system and water	- Every 6 month - 1 year	Secondary data from health unit in the area	Public health unit
	Helminthiasis	- Construction worker - Population in community	- Construction area		- Morbidity of helminthiasis	- Every 6 month - 1 year	Secondary data from health unit in the area	Public health unit
	Accident	- Construction worker	- Construction area		- Morbidity of disease of	- Every 6 month - 1 year	Secondary data from health unit in the area	Public health unit
Water collection/ Operation phase	Nutritional status	- Pre-school children - School children	- Project surrounding area		- Percent of child weight nutritional status low/ Over than standard	- Every 6 month - 1 year		Environmental unit / Public health unit
	Sexual transmitted disease (HIV, syphilis, gonorrhea)	- Population in community - Reproductive age group	- Irrigation area - Rear dam area		- Morbidity of Sexual relation disease	- Every 6 month - 1 year	Secondary data from health unit in the area	Public health unit

Table 3-5.2 Illustrative plans of following up and monitoring of health impact (The last portion of Table 3-5)

Project phase	Activity/ Impact	Risk group	Area	Indicators		Period/ Duration	Methodology/ Tools	Responsible person
				Environmental	Health			
Water collection/ Operation phase (Cont.)	Disease of alimentary system and water	- Population in community	- Irrigation area - Rear dam area		- Morbidity of disease of alimentary system and water	- Every 6 month - 1 year	Secondary data from health unit in the area	Public health unit
	Helminthiasis	- Population in community	- Irrigation area - Rear dam area		- Morbidity of helminthiasis	- Every 6 month - 1 year	Secondary data from health unit in the area	Public health unit
	Drown	- Population in community - School age	- Irrigation area - Rear dam area		- Morbidity of helminthiasis	- Every 6 month - 1 year	Secondary data from health unit in the area	Public health unit
	Algae poison disease	- Population in community	- Irrigation area - Rear dam area		- Morbidity of algae poison disease	- Every 6 month - 1 year	Secondary data from health unit in the area	Public health unit

3.6 Component of health impact assessment report

Previously, study on public health is under the topic of quality of life in report preparation of analyzing of environmental in order to make the study in the issue of health to wider cover in all aspects. Thus the integrated report of health impact assessment in the analyzing report of environmental impact should have the following components:



3.7 Staging to review draft report of study and health impact analyzing by public (Public Review)

After finishing up the report preparation the agency of project owner ought to organize the staging to reconsider or to reflect or to review the draft report of the study and the analyzing of health impact by public (Public Review) following the guideline of National Health Committee are:

1) Notice must be made to inform National Health Committee Office and public in general not less than 1 month prior action through public media not less than 3 channels.

2) Complete draft report of study and analyzing of health impact must be disclosed in order to allow concerned person and public in general to examine in advance not less than 15 days before staging through public media not less than 3 channels.

3) The staging review draft report of the study and the analyzing of health impact by the public must set up time duration to open chance for concerned person and the general public not less than 3 hours and not less than half of total of staging period.

4) Post staging of reviewing the draft of the study and the analyzing of health impact by the public, channel for hearing the comments must be continuously opened through at least 2 channels not less than 15 days.

5) Sum up comments report preparation of concerned person and people in general including comments and explanation from agency of project owner, approval agency and other permit/unit involved to hand to Office of National Health Committee to acknowledge and ready to disperse or distribute to the public

ANNEX 1

Table illustrating example of health determinant data of water development project

Type of health status data and health determinant	Data source	Work unit / method of data obtained
1. Individual health determinant		
1.1 Age	18 files	Health Centre/PBS.
1.2 Sex	18 files	Health Centre/PBS.
1.3 Occupation	18 files	Health Centre/PBS.
1.4 Income	BMN	Dept. of Local Administration
1.5 Education	BMN	Dept. of Local Administration
1.6 Health risk behavior ● Consumption behavior ● Risk behavior from agricultural chemical usage ● Sleeping behavior/toileting	Survey within area	
2. Community health determinant		
2.1 Social gathering group	18 files	Health Centre/PBS.
2.2 Hiring	BMN	Dept. of Local Administration
2.3 Life and asset safety	BMN	Dept. of Local Administration
2.4 Drug addicting	BMN	Dept. of Local Administration
3. Public health information service system		
3.1 Number of medical service unit ● Government sector ● Private sector		Provincial Public Health Office
3.2 Number of medical personnel		Health Centre/PBS.
3.3 Relieving of public threat		Dept. of Local Administration
4. Environmental health service information		
4.1 Waste management information (Garbage and refuse)	18 files	Health Centre/PBS.
4.2 Drinking and water supply service	18 files	Health Centre/PBS.
4.3 Residential sanitation	18 files	Health Centre/PBS.
5. Environmental information		
5.1 Physical environment e.g. dust, noise, vibration and etc.	Data collection added	Internet/ medias/related agencies
5.2 Chemical environment. i.e., heavy metal, inorganic matter, and etc.	Paper review/ news/research	

Note: BPS: Bureau of Policy and Strategy, Ministry of Public Health

BMN: Basic Minimum need

ANNEX 1 (Cont.)

Table illustrating example of health determinant data of water development project

Type of health status data and health determinant	Data source	Work unit / method of data obtained
5. Environmental information (Cont.)		
5.3 Biological environment, i.e., disease and animal carrier (fly), vector (mosquito, sand flies) and intermediate hosts (snail, fish, crab and etc)	Data collection added Paper review/ news/research	Internet/ medias/related agencies/Department of Disease control
6.Social health status data		
6.1 Morbidity	18 files	Health Centre/PBS.
6.2 Mortality from important contagious disease and non-communicable disease	18 files	Health Centre/PBS.
6.3 Morbidity of disease forecasting from project development ● Insect vector ● Helminthiasis ● Nutritional status	18 files/ Data collection adding	Health Centre/PBS.
6.4 Population mental health status	Mental health report	Area Mental Health Centre
6.5 Accident and injuries	18 files	Health Centre/PBS.
7. Related information of health impact that occurring from the procedure of the same type of development project	Paper review/ news/research	Internet/ medias/related agencies

Note: BPS: Bureau of Policy and Strategy, Ministry of Public Health
BMN: Basic Minimum need

ENNEX 2

Example of health impact from water resources development

In Sudan there were epidemic of abdominal parasitic disease causing death of 3,000 people in the catchment area through out 1,000 kilometers above Owenraw dam. And in the process of dam reservoir construction there were tree cutting but did not completing to bring away of scrapes of the wood from reservoir area causing the deteriorating and polluting water. It also reduced chance of gaining access to obtain drinking water of the people residing below the dam and inducing the epidemic of water borne diseases (Birley, 1995).

In Egypt, 3 years post Aswan Dam construction found schistosomiasis epidemic up to 60 % and at that time it could not be completely cured. In Thailand, from the study of Mahidol University in 1982 found that the result Ubolratana Dam construction gave raise villager's income up to triple times but at the same moment it induced liver fluke infection or opisthorchiasis to reducing life within a period of 3-5 years the villagers got sick from this disease up to 50.7% including problem of mal-nutrition in children was increasingly neglected. Whereas at Srinakarin Dam induced more epidemic of malaria and haemorrhagic fever whilst at Ratchaprapa and Banglang Dams gave raise of severe epidemic of elephantiasis and malaria (John. W.R., 1999)

Dam construction in the tropic and in arid areas will cause accumulation of nutrient elements or minerals very rapidly in particular during the first few years of water collection to causing the phenomenon of eutrophication leads to the spread of water weeds and toxic cyanobacteria known as blue-green algae or blue-green bacteria the etiology of liver cancer. Most of cyanobacteria will cause alimentary tract disease and some types of allergy in particular the arid area. There are many evidences in China indicating the relationship between liver cancer and the finding of cyanobacteria in drinking water (Zou Xioa Bing., 2005).

Direct riskiness from dam construction is the injuries from constructing, transportation of heavy materials and tools or equipments such as soil loader truck, truck, roller, transporting of soil and concrete making dangerous to road user. This can be seen road accidents from Kenji dam construction in Nigeria to cause dead and illness in which the death from such accident is more than from epidemic in the community (Birley, 1995).

During Cara dam construction found more 29 accidents to causing dead of 73 African workers by falling of rocks, traffic accident, car turn over, drowning and at the same time about 0-50% was a small accident needing first aid only. And the most occurrence of accident drawn from the report were during the first 18 months of construction (WHO, 1999)

From the report of Anon (1997) quoted by WHO, 2000 found that the storing of water in any dams is significantly reduce flow in river until the river can not dilute waste which is discharged into the river and not sufficient to support the natural level of animals and plants such as the conversion of

water from Yamuna River to upper and lower canals and the flow downstream is then limited by the dam resulted higher health risk rate in the tail water area due to the increasing level of pollutants and organism transmitting disease. Large size of water reservoir project and irrigation system has increased the underground water level in water control area to cause the change of calcium level and of other minerals. From information data of National Nutrition Institute in Hyderabad showed that the slow running flow from water reservoir and irrigation canals have increased underground water level resulted the increasing of molybdenum in the area growing millet and expanding of salty soil area.

ANNEX 3

Referencing source of sample used for

helminthic study

of

The Department of Disease Control, Ministry of Public Health

1. Sample size

Numbers of individuals in the sample used for study can be obtained from sampling of population to be survey for helminthiasis followed the guideline of household sampling by using 30 Clusters Simple Sampling Technique adopted by WHO with slightly modification. The sampling for the sample from 30 clusters or villages the sample size drawn from each cluster may be differed due to N and P (see below). The specifying of sampling site to draw sample follows standard regulation of social research by having known variable information such as total population (N) and ratio of helminthic infection in the population or prevalence (P) of each cluster from the past studied to substitute into the statistical formula to calculate for acceptable minimal sample size as the following details:

$$n = \frac{Z^2_{\alpha/2.}NP}{Z^2_{\alpha/2}P_{(1-P)} + (N-1)d^2} \text{ X Design Effect}$$

Whence n = Minimum sample size

N = Total population of each study area

$Z_{\alpha/2}$ = Value of area under normal curve specify to a 95% of confidence limit of accepted hypothesis at $\alpha/2$ of statistically significant when specifying $\alpha/2 = 0.05$

Thus $Z_{\alpha/2}$ = $Z_{0.05/2} = Z_{.975}$ equal to **1.96** (from normal distribution table)

P = Ratio of helminthic infection of population in each area or prevalence (P) receiving from previous studied usually less than 1

d = Margin of error allowance specify at 5%, **thus d = 0.05**

Design effect is usually specify = 2

Note: The **design effect** is particularly assigned only for helminthic survey research since the target populations in each sector are very widely varied in term of various of heterogeneous in and/or between groups or cluster led to getting back numbers of stool sample always less than expected or lower than minimum of calculated sample size. To correct this problem thus the numbers of collected individual in the sample have to be increased high enough to prevent any

hawthorn or confounding effect during the study such as number and quantitative amount of stool sample received is not sufficient for analytical as well as time limited to follow up the collection and etc. Thus, the word “design effect” in term of quantify number is introduced into the formula to double or even triple the sample size with the aim of preventing lost as well as to increasing effectiveness of the study or investigation.

We also can be noticed that after substituting the N and P values obtained from each cluster into the formula will give rise number of individual in the sample or the sample size always different from place to place stated above. This is the major cause of failure if we obtained stool sample less than number of calculated minimum sample size will be led to the result of study not represent the real fact of entire population or entire area or the study in not statistically significant. Thus the specifying design effect equal to 2 it can be guaranteed not only that most of hawthorn effect is initially prevented but also increasing the effectiveness and reliability of the study or investigation. At the same time we can do pair activities between stool collection for examination and interviewing the subject that all handed stool specimen in which must be correctly identified to be the same person to interview to suit the objective of the research study.

2. Stool collection and examination technique

2.1 Stool collection technique

Stool sample used for examining for the presence of helminthic and protozoal infection can be collected by distributing plastic box size #2 with label of specific name, age and sex of target person on water resistant glue paper stick to the side of the before distribution paired with interviewed paper direct to known subject by local survey team (from canton, district and/or provincial heath centre/sector) and village health volunteer (VHV). The plastic box containing stool will be collected back in the morning of the next day by the same VHV person. The stool collection will be performed for 3 consecutive days in order to providing chance for constipated person to hand the stool sample during the specified time period. The success of the action is usually over 60% hence the coverage is enough to cover the minimum number of sample size if the 2 of design effect is applied to multiply in the formula. Specific duty of co-operative team (from central and sector units) is initially to distributing plastic box mentioned above and collect stool sample {Handing on permit paper (form of agreement to be the subject), and complete interviewing and fill up the interview form of each subject will also be acted by this team with the aid of VHV} back to process stool examination as the following details.

Each of obtained fresh stool sample about 10 grams in plastic box size # 2 in the morning will be divided into 4 parts prior to examining as follow:

1) The first part about 2 grams will be used for examination using Formalin Ether Concentration Technique and recording all details of subject (fecal owner: name, age, sex, address and etc.) including the results of examination in the report form.

2) The other 3 grams (depending on availability) will be kept fresh at $4^{O}C$ to waiting for the result of above examination. If positive for liver fluke and/or hookworm infection, this fecal specimen will be added to positive pooled samples to be randomly drawn for a chance

to be checked for severity of infection. If it is not being picked this part of feces can be fixed for private expertise confirmation mentioned below.

3) The rest of 2 parts of fresh feces; the first part if available enough will be used for rechecking by using the same technique as done by above in 1) otherwise will be fixed and sent to private expert for rechecking or confirmation by using the same technique.

2.2 Stool examination process

There are 2 parts of actions:

2.2.1 The first part is the examination for prevalence of helminthic and protozoal infections by using Formalin-Ether Concentration Technique (Ritche, 1948) with a slightly modification. This method is considered to be high standard and most sensitive technique used for research survey of Ministry of Public Health and routine use or in house examination in the university. This method is very sensitive for examination of helminthic ova and cyst of protozoa even in low intensity of infection includes the larva of Strongyloides parasite.

2.2.2 The second part is the study for the intensity or severity of infection in term of egg counting by using Modified Kato Katz Technique (Katz M., !972). The technical process of examination is to randomly drawn sample 20% in number from known positive cases (from above examination) from each of both opisthorchiasis and hookworm infection from each cluster. The result of egg count of each kind of parasites is then transformed to be number of egg per gram of feces (stool) prior comparing with the standard of WHO (World Health Organization, 1980 and Bureau of General Communicable Diseases Department of Disease Control, 2002) before judging the severity of infection of each parasite in each cluster.

2.3 Methodological procedure and technique used stool examination and egg count

2.3.1 Formalin Ether Concentration Method (Ritche, 1948)

This method uses 10% formalin solution for fixation and preservation of parasite objects and ether to remove fat and oil. At first, adds normal saline into plastic cup containing about 2 grams of feces sufficient to comminute about 10 -12 ml. of stool suspension prior to be strained in the funnel through 2 layers of surgical gauze into a 15 ml. centrifuge tube. The suspension is then centrifugalized at 1500-2500 rpm for 1-2 minutes, the supernatant decanted, and the particulate matter re-suspended repeatedly (if necessary) until the supernatant is clear. After an additional decantation the sediment is then mixed with 7 ml. of 10% formalin to re-suspended, and allowed to stand for about 5 minute prior to add 3 ml. of ether and caps with rubber cap and shacks the suspension vigorously and the cap should be cautiously loosen after shacking to release pressure prior to centrifuge at about 2000 rpm for 5 minutes and should have four layers of solution in result after the process is done. From the top respectively down are ether, debris plug, formalin and fecal sediment containing parasitic ova, larva and/or cyst of protozoa. Ring of debris can be loosen by passing an applicator stick or swab stick gently round the circumference of the tube before entire supernatant is pour off. Thin film of the sediment is placed on microscopic slide adds a drop of 2% iodine solution and makes well mix before

mounting with cover glass before examination under light microscope. This method provides a very good concentrate of protozoal cysts and helminthic eggs which are diagnostically high satisfactory.

2.3.2 Modified Kato Katz (Katz, M. 1972)**:**

Modified Kato Katz method is quite good to use for examination of certain helminthic infection of both to seeing the prevalence as well as the severity or intensity of infection since numbers of eggs or ova can be counted and evaluated per gram of feces to reflect the intensity with statistically satisfied. This technique was initially developed for examination of *Schistosoma mansoni* and *S. haematobium* and later proved to be good for ascaris, hookworm and liver fluke infection but less significant in oriental schistosome infection.

The main principal procedure is to filter feces through wire screen size 100 messes/inch^2 and embedding filtered stool into standard hole or of rectangular card board template or plastic sheet template on microscopic slide until completely filled up and then carefully removed off the template so that the cylinder of feces is left on the slide then uses presoaked cellophane stripe (left over night in mixed solution of glycerin and malachite green) and spread fecal sample under cellophane strip evenly and thin enough so that helminthic egg or cyst of protozoa can be seen under light microscope. Steps of procedure and detail of practice are:

1) Uses wood flat spatula to collect about 3 grams of fecal sample by random scraping from various point of sample mixed and placed on blotting paper # 200 to absorb excess water follow by

2) Placing metal screen size 100 messes / inch^2 on top of sampled feces and carefully presses the screen using forceps to reinforce so that the feces will be filtered

3) Uses wood flat spatula to scoop filtered fecal sample enough to add and completely filled up in the standard hole of rectangular card board template size 6 millimeters of diameter and 1.37 in height (= the thick of card board) which is priory placed on microscopic slide size 1x3 inches

4) Carefully removed off the template so that the cylinder column of feces is left on the slide just in case if some part of feces stills remained onto the side of the hole it is needed to take off and bring to mix with the main part to prevent the erroneous.

5) Cover the filtered fecal sample with the pre-soaked (as previously described) cellophane strip 48 microns in thick and 2.5 x 3.5 inches in size

6) Uses rubber stop cock # 8 to press on cellophane strip to spread fecal sample under the cellophane strip evenly and thin enough to examine in all part of the cover so that all helminthic eggs and/or cysts of protozoa can be seen and counted under light microscope.

7) Leaves the already prepared slide in room temperature $\approx 27^{O}$C about 20 minutes for fecal digesting process (if temperature is higher the time allowance for digestion will be

shorter and the observation must be carefully performed to prevent over looked for unclear object due to over digestion)

8) Separates the counting of each all kinds of ova and/ or cysts through out the slide in order to use for approximating for the severity

9) The approximation can be made from calculating for the number or intensity of egg per gram of feces by using the formula:

No. of egg per gram of feces = Total number of counted per slide X 23

By given:

An average weight of filtered fecal sample used = 43.7 milligrams

Assuming the total number of egg counted/smear = N eggs

Thus, number of counted from 43.7 mg of feces is equal to N eggs

Then the total number of egg per gram of feces (EPG) = $\frac{N \times 1000}{43.7}$ eggs

= N X 22.88 or $\approx$ 23

Hence 23 is considered to be a constant factor number

Therefore, it can be presumed and concluded that the total number of egg in 1 gram of feces is approximately equal to **N X 23 eggs**

Interpretation of egg load to be the severity level of helminthic infection

Table 1 Illustration of severity level of liver fluke infection in accordance with WHO benchmark

Number of liver fluke egg/gram of feces (EPG)	Severity level
< 1,000	Low
1,000 - 9,999	Moderate
10,000 - 29,999	High
> 29,999	Very high

Table 2 Illustration of severity level of hookworm infection (*Necator americanus*) in accordance with WHO benchmark

Helminthic infection (Genus and species)	Number egg per gram of feces (EPG)	Severity level	Number of adult worm
Necator americanus	< 2,000	Low	< 51
	2,000 - 7,000	Moderate	51 - 200
	> 7,000	High	> 200

ANNEX 4

Example of interview form use for interviewing people in health behavior aspect

Studying helminthic and protozoal status in dam project

Data code: .....

Cluster No.....

Code of informant.....

House No.....Moo No.....Village.....Canton.....

District.....Province.....

How to fill up information: Interviewer mark ✓ in front of most correct information from sum up

General information:

1. Gender 1 Male 2 Female
2. Full age in year .....Year
3. Religious 1 Buddhist 2 Christian
   3 Islam 4 others (specify).....
4. Highest education 1 Non/below primary
   2 Primary (grade 4/ grade 6)
   3 Secondary
   4 High school
   5 Higher than high school (specify).....
5. Main career (Source of main income of family)
   .....1.....Agriculture (Farming/Rubber/Fruit gardening)
   .....2.....Raising animal
   .....3..... ..Trade/Business
   .....4..... ..Hire/private employee
   .....5.....Official/state enterprise employee
   .....6.....Others (specify)
6. Number of house member.....Person(s)
7. Toilet in house ( ) Yes and use ( ) No but at other's ( ) No and not use

Health behavior concerned information:

8. Food eating behavior about fresh water fish, other kinds of meat and various kinds of crabs dishes under improper cooked during the past 1 year

Food / Characteristics	Food consumption				Not known / Not local		
	Freque-ntly	Occasi-onally	Yes but quit	Never eating			
8.1 Koy pla (raw)							14
8.2 Larb pla (raw)							15
8.3 Pla som (raw)							16
8.4							17
8.5							18
8.6							19
8.7							20
8.8							21
8.9							22
8.10							23
8.11							24
8.12							25
8.13							26
8.14							27
8.15 Raw beef							28
8.16 Improper cooked or salted fresh-water crabs: e.g. rice field crab, water-fall crab and etc.							29

9. Preventive behavior against helminthic infection during the past one year

Preventive behavior against disease	Practicing				
	Often	Sometimes	Never		
9.1 Wears slipper: when go out/walk on soil					30
9.2 Wears shoes: when go out/walk on soil					31
9.3 Wears boot: to works in farm/garden etc.					32
9.4 Walking with bear foot when go out/ works in farm/garden etc.					33
9.5 Washes hand before eating/after defecating					34
9.6 Clean wash vegetable before eating					35
9.7 Eats well cooked dish of fresh-water fish					36
9.8 Eats well cooked dish of pork/cattle/sheep /goat meat					37
9.9 Eats well cooked dish of fresh-water crab					38

Health behavior concerned information: (Conti.)

10. Preventive behavior against the dispersion of helminthic disease during the past 1 year

Preventive behavior against disease dispersion	Practicing			
	Often	Sometimes	Never	
10.1 Defecates in sanitary toilet at home				39
10.2 Defecates in sanitary toilet when go to work in farm/garden/rubber				40
10.3 Never defecates in sanitary toilet at work in farm/garden/rubber				41

11. Behavioral acceptance for the servicing and treating of helminthic infection during the past 1 year

Stool examination	Used to	Never	Not interest	
11.1 Receiving stool examination				42
11.2 Receives anthelmintic drug from health centre (in the case of previous positive examination according to 11.1)				43
11.3 Kinds of worm used to be found in the feces from previous examination (according to 11.1); can answer more than 1 ( ) Hookworm ( ) Ascaris ( ) Whipworm ( ) Pinworm ( ) Strongyloides ( ) Liver fluke ( ) Others ( ) Not known of kind				44

Data information of health volunteer dealing with diarrhea

12. During the past 3 months did you have diarrhea symptom; fluid stool, often, off an on?

( ) Yes ( ) No 45

If yes, continue to answer No. 13

13. Does the symptom of diarrhea was liquid stool, often, off and on, mucous or bloody mucous?

( ) Yes ( ) No 46

ANNEX 5

Example of health behavior survey

for surveillance and prevention of schistosomiasis in dam project

Name of informant.....

House No.....Moo No.....Village.....Canton.....

District.....Province.....

How to fill up information: Interviewer mark ✓ in front of most correct information from sum up

1. Sample No...... ☐☐☐☐ (1 2 3 4)

2. Sex **Male** **Female** ☐ (5)

3. Age .....Years ☐ (6)

4. Main career of the family

☐ Farming ☐ Field ☐ (7)
☐ Hiring ☐ Trader
☐ Fishing ☐ Others (Specify).....

5. Is there any one in the family go to work in other place during the past year? ☐ (8)

Yes No

6. Is interviewee ever gone to other province or foreign country during the past 1 year? ☐ (9)

6.1 Other province ☐ No ☐ Yes (Specify).....
6.2 Foreign country ☐ No ☐ Yes (Specify).....

7. During daily life have you had any chance to contact with natural water and how?

7.1 Contacting

☐ Never ☐ Sometime ☐ (10)
☐ Almost everyday ☐ Everyday

7.2 How

☐ Bathing ☐ Washing clothes ☐ (11)
☐ Playing ☐ Fishing
☐ Others (specify).....
☐ Not connected

7.3 Time period of each water contacting ☐

☐ < 30 minutes ☐ > 30 minutes not over 1 hour (12)
☐ Between 1-3 hours ☐ More than 3 hours
☐ Not connected

7. During daily life have you had any chance to contact with natural water and how? (cont.)

7.4 After water contacted how did you make body to dry? ☐

- ☐ Just let it dries 13
- ☐ Quick rubbing
- ☐ Repeat bathing with well water or tab water at home
- ☐ Not connected

7.5 Normally while you were in water did you ever urinate or not? ☐

- ☐ Normally do 14
- ☐ Sometimes
- ☐ Never
- ☐ Not connected

8. During the past 3 years did you have stool examination or not? ☐

☐ Never ☐ Yes 15

9. During the past 1 year did you have stool examination or not? ☐

☐ Never ☐ Yes 16

10. At present do you defecate out side the latrine and how? ☐

- ☐ Frequently 17
- ☐ Some day
- ☐ Never

11. In this area, defecating out side latrine will have chance to disperse what disease? ☐

☐ Diarrhea	☐ Dysentery	18
☐ Intestinal helminth	☐ Liver fluke	
☐ Blood fluke	☐ Other(s) (Specify).....	

12. Water contacted in this area will have any chance to get what disease? ☐

☐ Do not know ☐ Yes (Specify)..... 19

13. Have you ever known about Schistosomiasis, previously? ☐

☐ No ☐ Yes (Specify source)..... 20