SECOND WORKSHOP ON COSTING OF IMPROVED DRINKING-WATER SUPPLY SYSTEMS FOR LOW-INCOME COMMUNITIES

Luang Prabang, 29 -31 October 2008

Report of an inter-regional workshop
with participants from Cambodia, Indonesia, Lao PDR,
Philippines, Thailand and Viet Nam

World Health Organization

World Health Organization, 2008

WHO/HSE/WSH/08.13

Report of the

SECOND INTER-REGIONAL WORKSHOP ON COSTING OF IMPROVED DRINKING-WATER SUPPLY SYSTEMS FOR LOW-INCOME COMMUNITIES

Luang Prabang,
29 -31 October 2008

Organized by the World Health Organization,
in collaboration with Nam Saat, Vientiane, and
with support from
the Department of State of the United States of America

Table of Contents

Report of the second inter-regional workshop on costing of improved drinking-water supply systems for low-income communities

Luang Prabang, 29-31 October 2008

1. INTRODUCTION

In the context of the collaboration between the World Health Organization and the University of Geneva on issues relating to the economic evaluation of water, sanitation and hygiene interventions, two guidance documents have been developed, on the cost analysis of drinking-water supply and of sanitation options, respectively. The counterparts of the collaboration under this "RUIG" programme are the Water, Sanitation, Hygiene and Health programme, Department of Public Health and Environment, World Health Organization, Geneva, and the Department of Econometrics, Faculty of Economics of the University of Geneva.

The first guidance document, a Practical Manual for Costing Improved Drinking-water Supply Systems for Low-income Communities (Carlevaro and Gonzalez, 2008) prepared by the Department of Econometrics, contains appropriate material for capacity building at the national level. Country capacity in the various components of the economic appraisal of proposed drinking-water supply and sanitation projects is needed in the final run-up to achieving the MDG targets on water and sanitation, and to sustain the momentum of investment in this area after 2015.

WHO commissioned a number of global economic analyses of investments in drinking-water and sanitation, and their returns. These indicate the returns to range from US$3 to US$34 for each US$ invested. However, such global analyses are based on assumptions that introduce a broad range of uncertainty in the outcome, and it is therefore pertinent to provide WHO Member States with the tools and know-how to carry out such analyses in the national context where levels of certainty can be enhanced.

From this perspective, it was decided to embark on a project that would combine pilot testing of the Practical Manual with capacity building in the area of costing, for a number of selected countries in the South East Asia and the Western Pacific Regions of WHO.

Support for this activity was provided by the Department of State of the Government of the United States of America, through a special grant to WHO, covering five of the six countries. For one country, Indonesia, support was provided from the budget of the WHO country office in Jakarta.

Objectives

- Knowledge on detailed criteria, procedures and methods conveyed to drinking-water supply decision-makers in six countries in Asia
- Guidance document applied to drinking-water projects in the six countries and results documented
- Experience and conclusions of the application of the guidance document synthesized for further use in the region and beyond

The elements making up this activity were the following:

- First workshop: Khon Kaen, Thailand, 3-6 March 2008
- April-September 2008: implementation country protocols
- Second workshop: Luang Prabang, 29-31 October 2008

The first workshop of three-and-a-half days introduced general economic evaluation methods, focused on the guidance document and developed the protocols for its testing in the six countries. This report covers the proceedings and outcome of the second, three-day workshop where reporting and feed back on the case study experiences was combined with a final synthesis of conclusions and recommendations.

In Annex 1, the programme of the second workshop is presented. The list of participants is presented in Annex 2.

2. WORKSHOP PROCEEDINGS

The second workshop on Costing Improved Drinking-water Supply Systems in Low-income Communities was held at the Naviengkham Hotel in Luang Prabang Lao PDR from 29 to 31 October 2008. Local organization was the responsibility of Nam Saat, the National Centre for Drinking Water Supply and Sanitation in the Lao Ministry of Health, in collaboration with the World Health Organization and the University of Geneva.

The ***objectives*** of the second workshop were

- Review and discuss the case studies based on protocols agreed in Khon Kaen.
- Review and discuss the lessons learned from applying the Practical Manual and the associated spreadsheets
- Discuss options for follow-up action in the countries after the workshop

The ***expected outputs*** of the second workshop included:

- Updated case study reports: 13 case studies from six countries
- Recommendations concerning improvements of the Practical Manual and the associated spreadsheets
- Needs assessment of a Practical Manual on the Social Cost-Benefit Analysis of Sanitation Options
- A list of priority capacity building actions in the individual countries aimed at mainstreaming the costing method in drinking-water project planning and implementation

To achieve these objectives and expected outputs, the workshop programme was structured around presentations that provided a framework update, followed by country presentations on the outcome of the case studies. Next, two working groups looked at lessons learned and obstacles that came to light during the case study implementation. The country teams then presented their observations with respect to the guidance document, which ended in a constructive exchange of ideas with the two authors. On the last day of the workshop the participants formulated their recommendations with respect to the further development of the Guidance document, and identified the priority capacity building needs in the individual countries. The summary structure of the programme is presented below and the detailed programme of work is attached as annex 1.

Wednesday:
- morning: Update on developments related to economic evaluation of water and sanitation; USAID perspective on WATSAN action in the region
- afternoon: Presentation and discussion of the country case studies

Thursday:
- morning: Group work on lessons learned and unclarities, followed by plenary discussion
- afternoon: Presentation of observations and comments on the Guidance document; presentation of the draft guidance document for costing of sanitation options.

Friday:
- morning: Discussion of the spread sheets;
- afternoon: Adoption of conclusions and recommendations.

The workshop was attended by 15 participants from six countries: Cambodia, Indonesia, Lao PDR, Philippines, Thailand and Viet Nam. A list of participants is presented in annex 2. Country participants represented government agencies responsible for health, water supply and sanitation, planning, finance and investment, and there were also a number of NGO participants involved in drinking-water and sanitation projects. WHO staff members from the Lao PDR country office and HQ were in attendance as well. The two authors of the Practical Manual participated as resource persons, and there were observers from the regional USAID programme and the Cambodian World Bank WSP. In follow-up to the workshop all participants received a set of two CD ROMs with all material presented and produced during the sessions as well as further background documents.

Opening

The second workshop on Costing Methods of Improved Drinking-water Supply Systems for Low-income Communities was formally opened on 29 October 2008 in Luang Prabang. The following statements were made:

Dr Soutsakhone Chanthaphone opened the workshop in his capacity of Deputy-Director of the National Water Supply and Sanitation Centre of Lao PDR and started by recalling that today's workshop was a follow-up to the first one held in Khon Kaen, Thailand in March of 2008.

In Lao PDR, Government programmes in water and sanitation have several links to the MDGs, to the National Poverty Reduction Strategy and to the National Socio-economic Development Plan 2006-2010.

A recent national census showed that, as a result of the various Government activities, 60% of the people now have access to safe drinking water (rural and urban combined) – and this figure is to reach 80% by 2015 and 90% by 2020. These goals surpass those set under the MDG 7 target. Sanitation continues to lag behind with 46% access – and also water quality management requires further investment in terms of improved management capacity.

Dr Soutsakhone welcomed all participants to Luang Prabang and wished them a pleasant stay.

Professor Fabrizio Carlevaro of the Department of Econometrics of the University of Geneva, Switzerland expressed his great pleasure of meeting many of the participants of the Khon Kaen workshop again at this second workshop in Luang Prabang. Both he and Dr Gonzalez had read the reports of the six country teams with great interest. Altogether these reports cover 13 projects and five of the six types of improved drinking-water technologies deemed potentially useful by the WHO/UNICEF JMP to ensure a safe supply of drinking water. An analysis of the problems encountered by the teams in using the Manual would help him and Dr Gonzalez to further improve the Manual and to make the accompanying Excel spread sheets more user-friendly. Professor Carlevaro expressed his thanks to the Geneva International Academic Network which supported his participation and that of Dr Gonzalez in this activity.

Mr Daniel Wilusz of the US Department of State pointed to the importance the American Government attaches to supporting water supply and sanitation worldwide. The 2005 Water for the Poor Act creates the basis for enhanced support globally and a budget of 600M US$ in FY2007 had ensured extension of access to drinking-water for two million people, and of access to sanitation for 1.5 million. On the whole, this area of international development has been energized over the last couple of years and the US authorities want to support planning and decision-making tools such as the one discussed at the workshop to further enhance the impact of its aid. This implies capacity building at the country level, in particular institution strengthening. In a parallel way, the US Government has been supporting the development of a water safety plan (WSP) in Hyderabad, India, and the costing method proposed would be a useful addition to this catchment-to-consumer risk assessment and management tool.

On behalf of the WHO, *Mr Robert Bos* recalled two important global drinking-water and sanitation events that had taken place since the first workshop in Khon Kaen, Thailand in March 2008. In May 2008 the latest report of the WHO/UNICEF Joint Monitoring Programme (JMP) was launched during the session of the Commission on Sustainable Development (CSD), with encouraging news for drinking-water coverage – for the first time the estimated number of people without access to safe drinking water had dropped below the one billion mark. The news for access to basic adequate sanitation was less encouraging with only a slight drop in those lacking access from 2.6 to 2.5 billion.

In September 2008, the mid-term high-level event for the MDGs, during the UN General Assembly sessions, was the occasion for the launch of the UN-Water/WHO pilot report on the Global Annual Assessment of Sanitation and Drinking-water (GLAAS). This annual assessment looks, *inter alia*, at funding streams and investment trends in water and sanitation and aims to become a new benchmarking tool. In both events, the economic dimension of extending access to safe water and sanitation was clearly apparent and this takes us back to the current workshop.

Increasingly, governments and bilateral/multilateral support agencies want a clear indication that proposals for water and sanitation projects have been subject to a reliable economic analysis. This will become all the more important as the current financial crisis unfolds further. The subject of this workshop is therefore essential for optimal performance in the future and to maintain the positive trend towards meeting the MDG7 target.

Thanks were due to the WHO staff in Geneva, Manila, Phnom Penh and Vientiane for their efforts in the preparation for this workshop and to the participants for their timely submission of case study reports.

Presentations to set the stage and for general information

USAID/RDMA
Dr Saengroaj Srisawaskraisorn presented the perspectives of the USAID/RDMA Regional Water and Sanitation programme in terms of specific needs and the response of the US Government. Environment is critical to growth and security in Asia, which, as a region, is highly vulnerable to global, regional and national environmental degradation. This degradation of the natural environment impacts economic growth, livelihoods and human health. It is compounded by corruption and poor governance that lead to conflict over natural resources.

Drivers of environmental change in Asia include the highest regional economic growth worldwide, a population density that is 1.5 times the global average with increasing industrial production and agricultural intensification. Two thirds of world's poor live in Asia, and the urbanization picture shows that 12 of the world's 20 mega cities are in Asia. In all, an estimated 660 million people are without access to safe water; 2 billion without access to improved sanitation.

Other environmental indicators include a declining natural capital – shrinking forests, declining biodiversity, an expected three-fold increase in CO_2 emissions from 2002-2030, and a relatively high rate of natural disasters (80% in Asia).

Many of the environmental challenges have transnational or regional causes and impacts, and solutions therefore require regional interventions. This translates into a need for effective and efficient coordination by USAID with regional and international organizations and networks, and a need for effective and efficient coordination with US Government bilateral programmes and initiatives. The RDM/A Regional response has a range of foci, topics and mechanisms that were further specified in detail.

The conditions in Asia with respect to access to drinking-water and sanitation are as follow:

- 600 million people lack access to safe water
- 2 billion people lack access to improved sanitation
- 1.7 million deaths per year could be prevented with access to safe water and sanitation
- $1 of water and sanitation investment yields $30 return
- Poor water/sanitation management can reduce GDP by more than 2%
- $90 billion could be saved annually by reaching internationally agreed targets for water/sanitation
- Twice as many people in China, India, and Indonesia die from diarrhoeal diseases than from HIV/AIDS

From the US Government Foreign Assistance perspective, the Water for the Poor Act of 2005 occupies a central place, as it:

- authorizes assistance to developing countries for safe water and sanitation;
- requires the Department of State in consultation with USAID to develop an assistance strategy;
- facilitates a consistent/coherent strategy to foreign assistance in water and sanitation;
- sets objectives and links US Government efforts to achieving the MDGs
- reports annually to Congress;
- received a $300 million FY08 earmark (USAID).

The guidance given for earmarking indicates that the purpose of activities eligible for support should be the increase of sustainable access to or the improvement of the quality of safe drinking water and sanitation, and the improvement of hygiene. There are four eligible categories for total or partial attribution: drinking water supply, sanitation, and hygiene (WSH), water resources management (WRM), water productivity and water security. Other secondary criteria apply. A number of specific areas of activity, carried out in collaboration with several partners, were presented in detail:

- Sub-national financing for water and sanitation projects
- Market-based approaches to scaling-up sustainable water, sanitation and hygiene
- Facilitate twinning partnerships – improved policies, practices and systems
- Establish or strengthen regional networks – dissemination and replication of experience and best practices
- Collaborate with partner programmes – leveraging capabilities and resources
- Transboundary conflict management in the Mekong
- Private sector partnership – market-based approaches

Global Annual Assessment of Sanitation and Drinking-water (GLAAS)

The opportunity of several drinking water supply and sanitation professionals from the region being at the workshop was used to publicize the new GLAAS initiative. GLAAS is a UN-Water initiative led by the World Health Organization which aims to seek a new approach to reporting progress in sanitation, drinking-water and hygiene. This should lead to a strengthening of evidence-based policy making towards and beyond the MDG targets.

The characteristics of GLAAS include its global scope, its intention to move from sector status to sector capacity, and its objectives to consider aid effectiveness and to promote accountability and transparency.

GLAAS fits with already existing UN-Water activities - the WHO/UNICEF Joint Monitoring Programme and the World Water Development Report. It complements a number of one-off, selective or regional initiatives such as WSP CSOs, OECD-CRS, WHO/UNECE Protocol on Water and Health, EUROMED, development banks' assessments and UNDESA GIRWI.

The rationale for GLAAS consists of the need for a repository of evidence to make better-informed decisions. The information in this repository should be reliable, easily accessible, comprehensive and global, and it should be periodically updated.

Three approaches and methods will ensure the establishment and maintenance of GLAAS: information on access to sanitation and drinking-water, the allocation and stream of funds and an assessment of national capacities in terms of governance, policies, regulations and human resources.

The access datasets are readily available from the WHO/UNICEF JMP. Funding information will include an analysis of spending in relation to needs through external aid, government budgets, household and private sector allocations. Data sources will include OECD, government finance data, household surveys and the World Bank's living standards measurement studies. And private sector associations.

Capacity assessment will evolve from a qualitative self-assessment such as carried out by a number of pilot countries in 2008 to the assembly of more quantitative and disaggregated datasets.

Critical gaps include the lack of information on non-OECD external support agency funds, the lack of disaggregation of funding for water and sanitation and sector spending, and an incomplete method of quantifying capacity and needs.

GLAAS will have a number of outputs: a periodic global reports, web-based country and donor profiles and reports on trends and perspectives. The goal is to achieve global access to this information in support of policymaking. Next steps, following the publication of the 2008 pilot GLAAS Report will be a consolidation of collaboration with key actors, design and test the 2009 GLAAS survey and then undertake it between January and May 2009. More information can be obtained from WHO Water, Sanitation, Hygiene and Health (properzif@who.int)

Country case study presentations

The detailed case study reports submitted by the country teams can be obtained, with all their attachments and annexes, from the WHO Geneva Water, Sanitation, Hygiene and Health Programme. In the present report summaries of the case studies are presented together with the ensuing discussion points.

Cambodia
To achieve the objectives/outputs contained in the protocol developed at the Khon Kaen workshop, the EIC research team, under the guidance of Ministry of Rural Development of Cambodia, conducted this study on two selected proposed options out of the Tonle Sap Rural Water Supply and Sanitation Project (TSRWSSP). The selection was based on criteria equally developed during the Khon Kaen workshop.

The EIC research team then carried out three main activities:

- First, the EIC research team conceptualized the study through a desk review on the draft Practical Manual on Costing of Improved Drinking-water Supply Systems for Low-income Communities and documents related to the three proposed options of water supply selected from the TSRWSSP. Consultation with some key experts of the projects also took place for a more in-depth understanding of the scope of the study and of the three proposed options;
- Next, the EIC research team conducted two field surveys among relevant stakeholders using the questionnaire and guided by the University of Geneva. The first field survey was conducted with some key project experts and village authorities using the Physical-Technical and Socio-Economic questionnaires. This survey aimed to provide a better insight into the three selected villages/sites of the proposed water supply options, such as their urbanization characteristics and local hydrological/climate aspects. Both face-to-face interviews and focus group discussion were used in this survey. The second field survey was a market survey, which aimed to assess the cost of the three selected proposed options for drinking-water systems. The survey was done by face-to-face interviews with component suppliers and focus group discussion with relevant local authorities and villagers.

- Finally, the analytical report was completed, based on data available from the field.

There were only two technical options available for this trial, ***Deep Well*** and ***Water Pond***. These two options are of the TSRWSS project; belong to Ministry of Rural Development with support from Asian Development Bank grant. The two options are located in different villages --*Deep Well* is in Tiem Chat and *Water Pond* is in Tnout--, but in the same commune, district and province. The geography and socio-economic status of these two villages are basically considered to be similar.

Studied Deep Well Costing Items (April 2007)

Item	Activity	Unit	Quantity	Unit Cost (US$)	Total (US$)
1	Medium Well Drilling (boring, casing & screen installation, well cleaning) (average depth is estimated of 95 meter) (equipment and labor)	well	1	1,330	**1,330**
2	Casing	met	87	5	**435**
3	Screen	met	8	6	**48**
4	Developing the well (average 3 hours per well)	hour	3	20	**60**
5	Pumping test (average five hours per well)	hour	5	10	**50**
6	Water analysis (only to transport to PIU; not include testing charges)	sample	1	10	**10**
7	Hand Pump installation	set	1	460	**460**
8	Hand-pump platform and drainage channel (material and labor)	each	1	202	**202**
9	Initial chlorination and well cleaning		1	5	**5**
10	Transportation	well	1	101	**101**
	Total				**2,701**

Source: *Project Management Unit of Water Supply, TSRWSSP*

Water Pond Costing Items (January 2008)

Item	Activity	Unit	Quantity	Unit Cost (US$)	Amount (US$)
1	Excavation, slope compaction and dike construction	m3	9,600	1.5	**14,400**
2	100 mm PVC Casing pipe and fittings (material and labor)	M	20	6.11	**122**

3	100 mm PVC Screen and fitting (material and labor)	M	8	7.41	**59**
4	Brass Gate Valve	Piece	2	50	**100**
5	12mm Dia., 7 m length steel bar valve handle	Piece	2	5.5	**11**
6	Sand media (0.5mm-1.2mm)	m3	64	30	**1,920**
7	Reinforced Concrete Ring casting (ID- 1.06 meter; OD-1.2 meter; 0.5 meter height) (13 rings per well in average)	Each	26	12	**312**
	Reinforced Concrete Ring casting (ID- 1.06 meter; OD-1.26 meter; 1 meter height) (1 for head ring) (material)	Each	2	35	**70**
8	Installation of rings (including head ring) construction of base-foundation and well cover	Well	2	40	**80**
9	Hand pump platform and drainage channel (material and labor)	Each	2	200	**400**
10	Rovai Pump Head installation (3 sets per 2 wells)	Set	3	50	**150**
11	Labor for well digging	M	10	9	**90**
13	Culvert construction with protection (material and labor)	Set	1	150	**150**
14	Labor for sand filter construction	Set	1	300	**300**
16	Site mobilization and Demobilization	Ls	1	500	**500**
17	Survey works	Site	1	200	**200**
	Total				**18,864**

Source: *Project Management Unit of Water Supply, TSRWSSP*

The summary of the results obtained allows us to conclude that the Water Pond option is less costly, which is clearly indicated by *average incremental cost* (AIC) or *unit average equivalent cost* (UAEC) indicators. The proposed method is a useful tool to help decision-makers in making investment choices between types of WS projects. It allows establishing the economic value for each type of project. These values, associated with the social benefits of each project, allow us to make a cost-benefit evaluation of each project.

Overall, this costing model and the questionnaires are fine and applicable. The model is perceived, however, as complicated and too detailed. The level of detail does not match the financial data of proposals that are mostly made at an aggregated level. Thus, the disaggregated costs are either difficult or costly to obtain or they do not exist at all. The cost of obtaining these cost data would require considerable time and budget and would be disproportionate to the cost of the WS project itself. Beside, the operation and maintenance cost are the users' responsibility, and such cost was considered zero in this context.

In addition, some break-down costs are also considered non-necessary, such as those of *local* or *imported* materials or investment. To obtain these broken down costs is time-consuming, but does not affect this costing model in any way. Furthermore, this model does not include user's preference toward water from different WS options. Users have their own preference to each WS option in term of source of drinking-water. In the Cambodian case, people at the rural areas prefer surface water like water ponds, to under-ground water, like deep wells. Thus, people in the community provided with access to water from the deep well will still spend some money or time to get water from various other sources.

Finally, the model is also seen as not user-friendly. The interface looks complicated and too technical. Some formulas could be easily and unintentionally mal-manipulated by the user. A simpler interface is needed. With respect to the questionnaire: even if most questions work well for the Cambodian context, some, related to geography and type of transportation, need to be also adjusted: *Plain area* should be included under geographic characteristics and *moto and bicycle* should be included under Transportation types. Some data related to detail poverty/income and employment do not exist yet. These data could be obtained only through the perception of the village leaders.

Indonesia

The main purpose of the cost analysis of improved technologies for drinking-water supplies for indigenous communities was the preparation of a detailed costing of the options for technologies for rural drinking-water systems in villages with a view to effectively indicating alternative investments.

The outcome of the study shows the following results:

1. The Manual allowed the selection of the most efficient alternative investment for improved drinking-water supply technology.
2. The Manual helped optimize the use of the investment cost for the beneficiaries (households or inhabitants) in terms of improved drinking-water supplies technology.

The study was implemented, *post hoc*, in three villages under the Second Water and Sanitation for Low Income Communities II (WSSLIC II) project, which is funded by the World Bank. The locations include Cipanas (for piped gravity technology); Ujung Gebang (for shallow well technology) and Cisaat village (for dug well technology).

Focus Group Discussions (FGD) through the questionnaires were the method of choice in this study. The information collected in the field was then fed into the economic mathematical instrument, which was developed by Fabrizio Carlevaro and Cristian Gonzales from the University of Geneva.

The stages analyzed in this cost study, using the instrument, were the Full Cost Present Value (FCPV), the Average Equivalent Cost (AEC) and the Average Incremental Cost (AIC), investment costs, operational costs, maintenance costs and administrative costs.

From the study analysis, and based on investment restitution (AEC) during the investment period, it was concluded that the piping gravity technology was the lowest cost option (Rp 34,059,625.00)[1] and the dug wall option was the highest cost option (Rp 138,965,944.00). From the beneficiaries' perspective the piped water option has the lowest cost, compared to Rp 10,730,020.00/household for the dug well option. This may have occurred as a result of the different levels of coverage of the different options, with only 20 households benefiting from the technology improvement by the extended connection phase of the piping option; while 51 households benefit from the dug well. The difference arises also because the investment costs of dug wells is higher than the installation of a piped system.

There were no obstacles in data entry on the mathematical design provided. Difficulties arose in the villages because the dimension of costs of unskilled labour that was not based on working hours but on the daily wages. As the analysis output contains a shadow factor, the impact on the result is very significant, especially the one that is related to the relative efficiency of investment options.

Lao PDR

The studies were carried out in two villages, Napho and Naphong, following the procedure detailed in the originally agreed protocol.

Napho village is located in the southern part of Met district of Vientiane Province, about three km from Met district office and about 135 km from Vientiane Provincial Office. This area is characterized by hills and low mountains; with an elevation of approximately 1300 meters above sea level. The total area is about 25 km^2. A tropical monsoon climate prevails with two seasons: a rainy season (April – October), and a dry season (November – March), with an average rainfall of 2,400 mm/year. Average temperatures are 24^0 C, with a maximum of 37^0 C

[1] Exchange rate at the time of the project: 1 US$ equals 9200 Indonesian rupiahs

in April. A lateritic road links to the Met district office. This road can be used around the year; the village is served by public transportation, has permanent electricity, has a primary school, and also has a telecommunication system (access through landline and mobile telephones).

Naphong village is located in the middle of Hinheub district of Vientiane Province, about 25 km from Hinheub district office, and about 50 km from Vientiane Provincial Office. It lies in a sloped upland area, with an approximate elevation of 600 meters above sea level. The total area is about 40 km^2. The climate in the Naphong village area is similar to that in the Napho village area. A lateritic road of about 20 km connects the village to the National asphalt route No.13 north. It can be used during the whole year but with difficulty during raining season. Naphong village has no public transportation, has permanent electricity, has a primary school, and also has a telecommunication system (access to landline and mobile telephones).

The project in Napho Village is designed to provide drinking and domestic water to a population growing from an initial size of 564 inhabitants to a final size of 824 inhabitants, which will be reached in 15 years at an annual growth rate 2.9 %. A relevant costing of this project should therefore take into account the evolution in the level of services provided by the project by computing the life-circle production as the present value of the growth of inhabitants or households served during the project life-time. The details of this economic costing are presented in the first Excel spreadsheet below, developed to consolidate the cost component of the project into interpretable cost indicators.

The full cost present value (FCPV) of the project is evaluated to 430,801,906 kip[2] from which 81.8 % can be attributed to investment, 2.8% to contingency, 7.2% to maintenance, 4 % to operation and 4.2% to administration. This FCPV can be converted into an average equivalent cost (AEC) of 50,330,391 kip per year, representing the constant annuity to be paid during the project life-cycle of 15 years to refund the FCPV.

Unit costs can be derived by dividing the AEC either by the number of the project's households or the number of its inhabitants. This leads to a unit average equivalent cost (UAEC), identical to the average incremental cost (AIC), of 498,321 kip per household per year and 89,238 kip per inhabitant per year, respectively.

The Naphong village project is designed to provide drinking and domestic use water to a population growing from an initial size of 1,192 inhabitants to a final size of 1,732 inhabitants, which will be reached in 15 years at an annual growth rate 2.9 %. A relevant costing of this project should therefore take into account the evolving level of services provided by the project by computing the life-circle production as the present value of the growth of inhabitants or households served during the project life-time. The details of this economic costing are presented in the second Excel spreadsheet below, developed to consolidate the cost component of the project into interpretable cost indicators.

The full cost present value (FCPV) of the project is evaluated at 1,414,914,537 kip, of which 78.8% can be attributed to investment, 2.8% to contingency, 8.2% to maintenance, 4.8% to operation and 5.4% to administration. This FCPV can be converted into an average equivalent cost (AEC) of 165,303,822 kip per year, representing the constant annuity to be paid during the project life-cycle of 15 years to refund the FCPV.

Unit costs can be derived by dividing the AEC either by the number of the project's households or the number of its inhabitants. This leads to a unit average equivalent cost (UAEC), identical to the average incremental cost (AIC), of 1,020,334 kip per household per year and 138,678 kip per inhabitant per year, respectively.

[2] Exchange rate at the time of the study: 1US$ equals 8900 kip

Costing Questionnaire

User's guide reference: Costing Improved WS Systems for Low-income Communities. A Practical Manual - Appendix II.3.1

TYPE OF TECHNOLOGY	PIPED WATER INTO DWELLING PLOT OR YARD
Design Lifetime (years)	15
Number of Design Households	162
Number of Design Inhabitants	1,192
Annual Connection	1192
CURRENCY	Kip
Annual Social Discount Rate	8.0%
Month/Year of Actualization	August-08
Consumer Price Index (8/aa)	111

SHADOW FACTORS	
Unskilled labor wage	30,000
Foreing exchange	8,700
Opportunity cost of capital	8.0%
Water	
Land	
Other direct inputs	

Present Value of life cycle production or inhabitant served	10,202.90

Costs in Kip of 08/08

	FCPV in Kip	%	AEC in Kip Year	AIC per HOUSEHOLD AIC in Kip	UAEC per HOUSEHOLD AEC in Kip Year	AIC per INHABITANTS AIC in kip	UAEC per INHABITANTS AEC in Kip Year
TOTAL INVESTMENT COSTS	**1,114,400,422.70**	**78.8%**	**130,194,894.26**	**803,672.19**	**803,672.19**	**109,223.90**	**109,223.90**
Local Materials	362,277,879.97		42,324,759.86	261,263.95	261,263.95	35,507.35	35,507.35
Imported Materials	-		-	-	-	-	-
Local Equipments	-		-	-	-	-	-
Imported Equipments	-		-	-	-	-	-
Labour	666,201,406.22		77,832,007.12	480,444.49	480,444.49	65,295.31	65,295.31
Other investment costs	85,921,136.51		10,038,127.28	61,963.75	61,963.75	8,421.25	8,421.25
TOTAL CONTINGENCIES COSTS	**FCPV in Kip**		**AEC in Kip Year**	**AIC in Kip**	**AEC in Kip Year**	**AIC in kip**	**AEC in Kip Year**
Incidental costs	39,651,076.96	**2.8%**	4,632,417.28	28,595.17	28,595.17	3,886.26	3,886.26
	FCPV in Kip		**Kip Year**	**AIC in Kip**	**Kip Year**	**AIC in kip**	**Kip Year**
TOTAL MAINTENANCE COSTS	**115,351,900.13**	**8.2%**	**13,476,510.00**	**83,188.33**	**83,188.33**	**11,305.80**	**11,305.80**
Local Materials	104,534,345.37		12,212,700.00	75,387.04	75,387.04	10,245.55	10,245.55
Imported Materials	-		-	-	-	-	-
Local Equipments	-		-	-	-	-	-
Imported Equipments	-		-	-	-	-	-
Labour	10,817,554.76		1,263,810.00	7,801.30	7,801.30	1,060.24	1,060.24
	FCPV in Kip		**Kip Year**	**AIC in Kip**	**Kip Year**	**AIC in kip**	**Kip Year**
TOTAL OPERATION COSTS	**68,475,829.50**	**4.8%**	**8,000,000.00**	**49,382.72**	**49,382.72**	**6,711.41**	**6,711.41**
Local Materials	-		-	-	-	-	-
Imported Materials	-		-	-	-	-	-
Local Power Services	34,237,914.75		4,000,000.00	24,691.36	24,691.36	3,355.70	3,355.70
Imported Power Services	-		-	-	-	-	-
Labour	34,237,914.75		4,000,000.00	24,691.36	24,691.36	3,355.70	3,355.70
	FCPV in Kip		**Kip Year**	**AIC in Kip**	**Kip Year**	**AIC in kip**	**Kip Year**
TOTAL OTHER RELEVANT COSTS	**77,035,308.19**	**5.4%**	**9,000,000.00**	**55,555.56**	**55,555.56**	**7,550.34**	**7,550.34**
Administration	59,916,350.82		7,000,000.00	43,209.88	43,209.88	5,872.48	5,872.48
Training	8,559,478.69		1,000,000.00	6,172.84	6,172.84	838.93	838.93
Promotion & Education	8,559,478.69		1,000,000.00	6,172.84	6,172.84	838.93	838.93
Total	**1,414,914,537**		**165,303,822**	**1,020,394**	**1,020,394**	**138,678**	**138,678**

Costing Questionnaire

User's guide reference: Costing Improved WS Systems for Low-income Communities. A Practical Manual - Appendix II.3.1

TYPE OF TECHNOLOGY	PIPED WATER INTO DWELLING PLOT OR YARD
Design Lifetime (years)	15
Number of Design Households	101
Number of Design Inhabitants	564
Annual Connection	564
CURRENCY	Kip
Annual Social Discount Rate	8.0%
Month/Year of Actualization	August-08
Consumer Price Index (8/aa)	111

SHADOW FACTORS	
Unskilled labor wage	30,000
Foreing exchange	8,700
Opportunity cost of capital	8.0%
Water	
Land	
Other direct inputs	

Present Value of life cycle production or inhabitant served	4,827.55

Costs in Kip of 08/08

	FCPV in Kip	%	AEC in Kip Year	AIC per HOUSEHOLD AIC in Kip	UAEC per HOUSEHOLD AEC in Kip Year	AIC per INHABITANTS AIC in kip	UAEC per INHABITANTS AEC in Kip Year
TOTAL INVESTMENT COSTS	**352,429,212.75**	**81.8%**	**41,174,144.55**	**407,664.80**	**407,664.80**	**73,003.80**	**73,003.80**
Local Materials	119,583,265.29		13,970,858.47	138,325.33	138,325.33	24,771.03	24,771.03
Imported Materials	-		-	-	-	-	-
Local Equipments	-		-	-	-	-	-
Imported Equipments	-		-	-	-	-	-
Labour	146,924,810.95		17,165,158.80	169,952.07	169,952.07	30,434.68	30,434.68
Other investment costs	85,921,136.51		10,038,127.28	99,387.40	99,387.40	17,798.10	17,798.10
TOTAL CONTINGENCIES COSTS	**FCPV in Kip**		**AEC in Kip Year**	**AIC in Kip**	**AEC in Kip Year**	**AIC in kip**	**AEC in Kip Year**
Incidental costs	12,191,197.41	**2.8%**	1,424,292.05	14,101.90	14,101.90	2,525.34	2,525.34
	FCPV in Kip		**Kip Year**	**AIC in Kip**	**Kip Year**	**AIC in kip**	**Kip Year**
TOTAL MAINTENANCE COSTS	**31,087,633.29**	**7.2%**	**3,631,954.05**	**35,959.94**	**35,959.94**	**6,439.63**	**6,439.63**
Local Materials	27,940,877.47		3,264,320.00	32,320.00	32,320.00	5,787.80	5,787.80
Imported Materials	-		-	-	-	-	-
Local Equipments	-		-	-	-	-	-
Imported Equipments	-		-	-	-	-	-
Labour	3,146,755.82		367,634.05	3,639.94	3,639.94	651.83	651.83
	FCPV in Kip		**Kip Year**	**AIC in Kip**	**Kip Year**	**AIC in kip**	**Kip Year**
TOTAL OPERATION COSTS	**17,118,957.38**	**4.0%**	**2,000,000.00**	**19,801.98**	**19,801.98**	**3,546.10**	**3,546.10**
Local Materials	-		-	-	-	-	-
Imported Materials	-		-	-	-	-	-
Local Power Services	-		-	-	-	-	-
Imported Power Services	-		-	-	-	-	-
Labour	17,118,957.38		2,000,000.00	19,801.98	19,801.98	3,546.10	3,546.10
	FCPV in Kip		**Kip Year**	**AIC in Kip**	**Kip Year**	**AIC in kip**	**Kip Year**
TOTAL OTHER RELEVANT COSTS	**17,974,905.24**	**4.2%**	**2,100,000.00**	**20,792.08**	**20,792.08**	**3,723.40**	**3,723.40**
Administration	12,411,244.10		1,450,000.00	14,356.44	14,356.44	2,570.92	2,570.92
Training	4,279,739.34		500,000.00	4,950.50	4,950.50	886.52	886.52
Promotion & Education	1,283,921.80		150,000.00	1,485.15	1,485.15	265.96	265.96
Total	**430,801,906**		**50,330,391**	**498,321**	**498,321**	**89,238**	**89,238**

Philippines
The work in the Philippines started with a familiarization exercise with the Manual, questionnaires and spreadsheets, mainly through a desk review. Next the existing data were reviewed; most of the macro-economic (e.g., economic indices) and social (employment and literacy levels) datasets were available at the National Economic Development Agency and the National Statistical Office. Poverty maps such as those on the website of the NGO Peace and Development Foundation (PEF) also substantially contributed to the needed socio-economic information, especially as their resolution was municipal level, although not always in the exact form requested by the tools.

Macro-physical data such as rainfall patterns and community satellite maps were found on the websites of the Philippine Atmospheric, Geophysical and Astronomical Agency, the national Mapping and Resources Information Agency, and Google Maps.

Following this preliminary work, the Philippines team went ahead with the selection of sites, community level data gathering and the detailed implementation of the agreed protocol.

By fortunate coincidence, two NGO's allied with PCWS (PEF and the Institute for Popular Democracy or IPD) had identified several beneficiary communities that required water supply improvement, and from these, three were selected:

1) *Barangay* (village) Mat-I, a coastal rural community in the town of Santa Fe, Tablas island, Romblon Province, some 300km air km south of Manila.
2) *Barangay* Duyay, an interior rural community in the town of Boac, Marinduque island, about 200 air km south of Manila.
3) Maharlika, an urban poor community in *Barangay* Bagong Silang, Caloocan City at ther northern edge of Greater Manila.

The consolidated cost and benefit data obtained from these three villages are presented in the table below. The details of water supply options and questionnaire outcomes can be found in the full report, available from WHO/WSH.

The consolidated cost and benefit data are presented in the tables below.

The Mat-I project's biggest cost component is infrastructure construction. In Duyay, the biggest component turns out to be operation costs, but only because infrastructure construction costs are low. This in turn is due to the nature of the intervention, which is just to rearrange some pipes and to connect the piped network to some springs nearby. For Maharlika the biggest cost component is operations (i.e., the cost of bulk water purchased from the city utility).

It would appear that the annualized cost is affordable to users in the first two communities. In Mat-I, a household would only need to pay about 33 Philippine pesos (PHP)[3] a month for full project cost recovery; and for Duyay it would be about PHP 53.

For Maharlika the cost would be much higher (PHP 133 per household per month), but this is still affordable since urban incomes are higher than in the countryside.

It would appear that the three projects have favourable benefit-cost ratios, although admittedly the benefit estimates have not yet been discounted. Also, the benefit-cost ratio for Mat-I is low, if one takes into consideration a rule-of-thumb that for a water system to be sustained by its users, it should provide benefits to them at least twice and preferably four times the annualized costs.

[3] Exchange rate at the time of the project: 1US$ equals 45 Philippine pesos

	FCPV in PHP.						UAEC per INHABITANT		
	Mat-i		Duyay		Maharlika		Mat-i	Duyay	Maharlika
		%		%		%			
TOTAL INVESTMENT COSTS	**360,355**	**49.6%**	**82,160**	**12.6%**	**2,040,260**	**23.5%**	**40**	**16**	**93**
Local Materials	203,089	-	32,962		1,513,016		23	6	69
Imported Materials	0	-	0		0		0	0	0
Local Equipments	0	-	2,262		2,262		0	0	0
Imported Equipments	0	-	0		0		0	0	0
Labour	112,625	-	31,775		433,182		12	6	20
Other investment costs	44,640	-	15,161		91,800		5	3	4
TOTAL CONTINGENCIES COSTS									
Incidental costs	**130,839**	**18.0%**	**109,640**	**16.8%**	**379,344**	**4.4%**	**15**	**21**	**17**
TOTAL MAINTENANCE COSTS	**47,973**	**6.6%**	**18,650**	**2.8%**	**217,559**	**2.5%**	**5**	**4**	**10**
Local Materials	14,055	-	6,494		122,937		2	1	6
Imported Materials	0	-	0		0		0	0	0
Local Equipments	0	-	0		0		0	0	0
Imported Equipments	0	-	0		0		0	0	0
Labour	33,918	-	12,156		94,623		4	2	4
TOTAL OPERATION COSTS	**14,300**	**2.0%**	**294,967**	**45.1%**	**4,491,566**	**51.7%**	**2**	**57**	**206**
Local Materials	0	-	0				0	0	206
Imported Materials	0	-	0		0		0	0	0
Local Power Services	0	-	0		0		0	0	0
Imported Power Services	0	-	0		0		0	0	0
Labour	14,300	-	294,967		0		2	57	0
TOTAL OTHER RELEVANT COSTS	**172,768**	**23.8%**	**149,146**	**22.8%**	**1,551,238**	**17.9%**	**19**	**29**	**71**
Administration	172,768	-	149,146		1,551,238		19	29	71
Training	0	-	0		0		0	0	0
Promotion & Education	0	-	0		0		0	0	0
Total	**726,234**		**654,563**		**8,679,967**		**81**	**127**	**398**

Costing Figures For Mat-I, Duyay and Maharlika Water Improvement Projects

A BENEFIT COST ANALYSIS OF PROPOSED WATER SUPPLY IMPROVEMENTS IN THREE COMMUNITIES in PHP Per Year:			
	Community		
Item	**Mat-i**	**Duyay**	**Maharlika**
Reduction in Water Expenses	0	0	3,794,175
Reduction in Water-Fetching Labor:	44,417	265,269	4,265,938
Savings in water-using household chores labor	4,380	79,623	376,406
Improvement in Community Health	84,389	118,364	138,777
Creation of Livelihoods	1,413	3,862	6,366
TOTAL BENEFITS, Undiscounted	**134,599**	**467,118**	**8,581,662**
AEC in PHP/Year	109,759	98,927	1,311,845
B/C RATIOS	**1.2**	**4.7**	**6.5**

Based on the study the Philippines team formulated the following suggestions and recommendations:

- Using the costing tool is easy, especially if the user has water supply engineering and some water supply economics background and experience. Understanding how to use it is facilitated best by practicing inputting data and then checking the results.

- After inputting two data sets, proficiency can be enough to finish encoding data from one project every two or three working days. Much of this time is spent retrieving the data from project bills of materials and budgets and putting it in in the required format.

- The best way to use the tool is to write the requested data itself in the respective source bill of materials before transferring the results into the costing spreadsheet. For example, in generating tank cost data, the team found it faster to compute the investment materials, investment labor, maintenance labor, etc. subtotals in the tank bill of materials first, before linking them to the costing spreadsheet.

- Linking the source bills of materials to the costing spreadsheets also enables the person reading the latter to immediately view them when needed.

- Costing in water supply appears to be mostly straightforward. What would be more difficult but more useful especially in engineering design is the development/ adoption of benefit estimation spreadsheets that can be linked to the costing spreadsheets and the bills of materials. This enables the designer to try out various sizes of infrastructure and know their effect on the benefit-cost picture.

Two useful items to develop come to mind:
1. A casebook that will contain sample problems on estimating water supply benefits for various situations. The user can just peruse the book to determine which samples are most applicable to the situation he/she is analyzing. The book will also contain useful databases and algorithms.

2. A general water demand curve. Also called the Feachmann Curve, it predicts how much water a person will use for domestic purposes at various prices. This will be useful in the rapid estimation of benefits as a community moves up or down the curve as a result of a water supply project.

Thailand
The Thai team selected two trial sites from among 10 potential sites of primary investigation. The selection criteria were adjusted due to time and budget constraints. The final selection was based on location (rural Thailand), accessibility for site survey, variety in types of water source (surface and ground water) and availability of costing data (existing water supply system).

Both sites are in the Central region of Thailand and are representative of the low income and rural villages in that part of Thailand. Both trial sites have a new water treatment system. The two trial sites are:

Banpraduyean, Lansak District, Uthaithanee Province. The water source is ground water from a deep well. The treatment system is aeration and rapid sand filtration.

Bannongtao, Payuhakiree District, Nakornsawan Province. The water source is surface water from a pond. The treatment system is flocculation, sedimentation and rapid sand filtration. The system is not yet operational for lack of an electricity connection.

After retrieving records and collecting primary data, the team carried out the village surveys using the proposed questionnaires.

The physical-technical questionnaire for the rural water supply system in the first trial site Ban Praduyean, Mu8, Praduyean Sub-District, Lansak District, Uthaithanee Province, shows

that the majority of the community benefits from the project. The community is rural with a medium degree of poverty. (according to the national development plan, poverty in Thailand is defined as an annual income per head below 20,000 Baht[4]). Most of the villagers are farmers, they grow rice and tapioca mainly. The houses are rural with wooden wall.
Public services such as the primary school are in the sub-district of Praduyean. The communication road is accessible by car, bus, truck and motorcycle.

The present water supply system includes central treatment. The water source is ground water from an existing deep well. The treatment system is aeration and rapid sand filtration to eliminate iron (Fe) content in raw water. Sanitation and electricity are available.
The geographical situation of the village is plain area with an average temperature of 20-25 degree Celsius. The annual rainfall is within the range of central region of Thailand (1400 mm). According to socio-economic questionnaire, the majority of population is 15-64 years old (80%)

The details of the economic evaluation using the excel spreadsheet show that the full cost present value (FCPV) of the project is estimated at 1,704,773 Baht. From which 74.9% are due to investment costs, 19.2% to operation cost, 2.0% to maintenance cost and 3.8% to other relevant cost. This FCPV can be converted into an average equivalent cost (AEC) of 250,320 Baht per year, representing the constant annuity to be paid during the period of a 15-year life-cycle to refund the FCPV.

Unit costs are derived from dividing the AEC by the size of the project's household population or the size of the inhabitant population. Thus a unit average equivalent cost (UAEC), identical to the average incremental cost (AIC), amounts to 1,406 Baht per household and 410 Baht per inhabitants, respectively

The physical-technical questionnaire for the rural water supply system Bannongtao , Mu4, Payuhakiri District Nakonsawan Province, shows that the majority of the community should benefit from the project. The community is rural with a medium degree of poverty. (for definition, see above). Most of the villagers are farmers, they grow rice and sugar crane. The houses are rural with wooden walls.

Public services such as primary school are in the village area. The communication road is accessible by car, bus, truck and motorcycle.

The present water supply system relies on central treatment. The water source is surface water from a pond. The treatment system is flocculation, sedimentation and rapid sand filtration. Sanitation and electricity are available.

The geographical situation of the village is plain area with an average temperature of 25-30 degree Celsius. The annual rainfall is within the range of central region of Thailand (1400 mm). According to socio-economic questionnaire, the majority of the population is 15-64 years old (65%)

The details of the economic evaluation using the excel spreadsheet show that the full cost present value (FCPV) of the project is estimate at 3,376,906 Baht, of which 84.7% are attributable to investment, 11.6% to operations, 1.8% to maintenance and 1.9% to other relevant items. This FCPV can be converted into an average equivalent cost (AEC) of 495,812 Baht, per year, representing the constant annuity to be paid during the period of life-cycle of 15 years to refund the FCPV.

[4] Exchange rate at the time of the study: 1 US$ equals 34 Thai Baht

Unit costs are derived from dividing the AEC by the size of the project's household population or the size of the inhabitant population. Thus, a unit average equivalent cost (UAEC), identical to the average incremental cost (AIC), amounts to 4,634 Baht per household and 939 baht per inhabitants, respectively

Viet Nam

The Viet Nam case study aimed to collect and assess the costs of improved WS systems for low-income communities, using the costing methodology proposed by World Health Organization (WHO), with a view to evaluating the applicability and efficiency of the methodology in Vietnamese conditions. Based on evaluation, options for adjustment and supplementation of the WHO costing methodology were considered that would make the method applicable in Viet Nam.

There are a number of rural water supply models for Viet Nam. Each area, region and locality has its characteristics in terms of climate and water sources. As a result, the selection and utilization of water resources for domestic purposes differ from those for drinking and cooking purposes. In mountainous areas, the main sources are rainwater, stream water and water from fractures. In midland and low mountains and hills, water is mainly exploited from shallow water table and from Caster caves. Meanwhile, surface water and groundwater are main sources in delta areas and basin region.

For the time being, there are numerous water supply technologies applied in Viet Nam, ranging from traditional ones to modern ones. The application of different technologies in different regions depends on each region's conditions. There are some typical water supply technologies which are applying in Viet Nam as follows:

a. Small-scale and fragmented water supply technology

Tanks and jars are popular storage models of rain water. The former have been extensively used in rural areas for a long time while the latter have been developed over the past decades. Both mentioned models are being utilized and proved their effectiveness in the field of rural water supply in areas where surface water and groundwater are limited or the conditions for exploitation of surface water and groundwater are very difficult (high mountainous North of Vietnam, southern coastal region, Mekong Delta region, etc).

Dug wells and drilled wells: dug wells and drilled wells are now used popularly in rural areas, even in big cities such as Hanoi and Ho Chi Minh city. In areas where the quality of raw water is poor, water is treated by sand filters, Alluwat filters, floating materials filters with a view to removing dirty matters, manganese and microorganism from water. Groundwater is exploited from dug wells and drilled wells by hand pumps or small-capacity electric pumps. This technology is appropriate to households in terms of economic and technical matters. As a result, this technology is developed nationwide, from delta regions to midland. In general, drilled wells provide more stable quantities of water and better quality than dug wells. However, if they are not constructed according to the correct specifications and best practice and kept in hygienic conditions, water will be contaminated and become unhygienic.

b. Concentrated water supply technologies (so-called rural water supply plants or rural water supply stations)

These technologies include two main types:

Water supply by pumps: groundwater or surface water is exploited from drilled wells or intake facilities and then pumped to a water treatment plant. After being treated, water is conveyed by a system of pipes (PVC pipes, HDPE pipes, steel pipes) and distributed to households with water meters installed to measure the volume of water used by each household.

This technology is usually applied in areas where groundwater and surface water are abundant, in areas where population density is high, economy is developed and capacity of administration and operation is quite good, such as delta areas, midland and coastal areas.

Water supply by gravity: water resources (water from fractures, stream water) are usually selected in high positions. Water is gathered, treated and then led to resident areas located in lower positions by gravity through a system of plastic or steel pipes. In concentrated utilization points, clusters of hoses are installed, tanks are constructed or water is led directly to households.

This is a simple, low-cost, low-administrative, low-operative and effective technology. This technology can supply water to thousands of people and is extremely appropriate to dozens or hundreds of households. This model is very popular in the northern mountainous area and the Central Highlands where numerous courses of streams are existent and populations are dispersed over fragmented communities.

In conclusion, each water supply model has its characteristics, each has its own advantages and disadvantages and each model is appropriate to certain water sources, particular socio-economic conditions of each region and province. In each particular location, it is crucial to select suitable technologies with a view to promoting their effectiveness and minimizing their disadvantages.

There are a number of advantages of the costing methodology proposed by WHO over the Vietnamese costing methodology

- With the system of spreadsheets, the costing methodology proposed by WHO is an effective method for consultants and investors to consider investment options for each item or for the whole WS system for communities, especially low-income communities where the feasibility of the investment is regarded as a top priority. The consideration of a project's feasibility is only taken for the whole system, not for each item. In the case the feasibility for each item is considered, the calculation volume will be huge.

- The costing methodology proposed by WHO puts two factors: opportunity cost of capital and useful time of the system in its spreadsheets As a result, the calculation of economic factors in order to determine the investment costs per household is more accurate due to the fact that it compares with the other options of investment in other fields. Meanwhile, according to Vietnamese costing methodology, the comparison of different investment options is only provided in economic and technical reports of large projects. This information is not available for small-scale projects such as projects of water supply by gravity.

- The costing methodology proposed by WHO is able to calculate all investment costs during the useful lifetime of the project. Meanwhile, according to the Vietnamese costing methodology, investment costs are only calculated for the period of construction and not for subsequent periods (operation and maintenance).

Basically, the costing methodology proposed by WHO is accordance with Vietnamese regulations on study for establishment and technological design for WS projects. Its questionnaires are appropriate to datasets prevailing in Viet Nam. However, especially in low-income communities of Viet Nam, it is difficult to determine such factors as opportunity cost of capital and annual social discount rate by region as well as for the nation. Consequently, in the study case for Viet Nam, the two factors were provisionally regarded as being equivalent to basic discount rate of the State Bank of Viet Nam (Central Bank) at the moment of calculation.

Discussions ensuing from the country case studies

In connection with the Cambodia case study the Thai representation raised the question how water quality issues would come into the equation. Even if the water quality stays within the WHO guideline values, there may be differences related to source and treatment, and these should be reflected in the final economic analysis. Clearly, this took things into the area of benefit analysis and added a dimension to the overall evaluation. Similarly, the Lao representatives remarked that different sources implied differences in water collection practices and these should also be reflected in the opportunity costs. It was also pointed out that the analysis should, in principle, be community-based. There was general confusion about the use of shadow prices.

Professor Carlevaro responded and stated that the costs of collection should be included in an economic evaluation because collection uses resources that need to be considered. He questioned the use of the minimal lifetime: using ten years as the value here led to an overvaluing of the costs. It was better to reflect limits of uncertainty rather than absolute numbers in the figures.

With respect to the Lao case study, it was first of all pointed out that a cost analysis is both a comparative tool and a planning tool. The Philippines representatives asked whether in villages where there were already many water points it really made sense to bring in piped water, but the Lao response was that these project aimed to improved not only access per se but also the quality of the water accessed. The design lifetime used in the calculations should be extended and the maintenance costs should be taken on board. The Lao team also stated that the investment in water metering was justified because metering added to the sustainability of the system.

Professor Carlevaro commended the team for the first part of the two case study reports which were very detailed indeed, but he felt the part covering the analysis procedures could be elaborated into greater detail together with a technical presentation of the options. In settings where the population grows over time, the growing need for drinking-water needs to be reflected in the average incremental cost, and this requires the use of a different spreadsheet.

When discussing the Philippines projects, the Lao team asked how they had designated materials as being local as opposed to imported, as locally produced materials also had a significant impact on local economies. Also a question was raised with respect to the *per capita* water consumption in the two locations

Professor Carlevaro wondered where the text book values to calculate O&M costs and the shadow factors had come from – the Thai team explained that these values had been found on the internet. Also, the cost per cubic meter is a better basis for comparative calculations than the cost *per capita*.

The discussion of the Thai project again brought up the issue of a project's lifetime and how this should be defined. There was also the complication in these projects that remote houses were not served by piped water but that the households in those remote houses would have to rely on their neighbors for access to drinking-water.

Finally, the Vietnamese team responded to questions by explaining that the economic planning system in their country worked on the basis of conventions on how to spend funds of the State. Therefore, issues like VAT had been included, but other elements (such as O&M) were excluded, because they were dealt with at another administrative level.

Outcome of group work on lessons learned and remaining unclarities

Following the presentation and discussion of the country reports, the participants worked in two groups for one hour, to discuss among themselves their experiences in testing the Practical Manual. In particular, they were asked to address two questions (1) the main lessons learned from the case studies and (2) the issues that continued to be unclear. They summarized their conclusions on flipcharts and presented them as follows:

Group 1
Lessons learned:

1. Availability of WS options is limited

Finding different options for safe drinking water supply in a specific location in the real world is not easy. Different alternatives are not always immediately at hand to identify in a particular area. This lack of options makes finding the least-cost option a difficult challenge. So, in most case studies different options were analysed in different areas, but the questions that then remained were: what is the conclusion and what are the objectives?

2. Technical issues first

Engineering experts insist that technical issues should come first in the selection of options. For example, in a given village one particular technology will come out as technically the best option. While other technical options can be reviewed (well, pond, piped water system) for costing, the technical considerations will be overriding. In some areas, for example, a deep well is technically not viable because the ground water table is too low.. Then there is no other choice than opting for a pond.

3. O&M not easy to estimate.

It is difficult to estimate the O&M costs as a future prediction, but it is not impossible. The teams learned this is a major challenge. In some countries datasets exist that collect the information on the costs of O&M components based on experience.

4. Expertise needed

The spreadsheets are not straightforward and require technical inputs from engineers and economists. So an improvement is required to make them more user-friendly and better explain the step-by-step procedure required for filling them in properly.

5. Turn-over in workshop participants

Keeping people on track in the training is critical for continuity and also to build a robust knowledgebase in a number of people. Therefore, the attendance of the two workshops by the same people should have been assured.

Issues needing further clarification

1. Definitions
    - Shadow factor
    - Design life
    - Discount rate (social, annual)
    - Other economic terms (AIC, AEC, FCPV, UAEC

The manual should contain clear explanations of these definitions with illustrative examples.

2. Difference between local and imported materials (economic meaning)

3. Opportunity costs: concept needs further explanation in the manual

Group 2
Topic 1 Spread sheet format – some cells require locked formulas. It must be impossible to enter mistakes inadvertently. Some indicators could be adapted to local situations like cost/m^3 of water instead of cost per connection – so the question is: can the spreadsheet be customized to local needs and still lock the formulas?

Topic 2. Availability of data – questions remain about where to get certain macro economic data and indicators/factors.

Topic 3. How does the socio economic survey relate to the data entry in the spread sheets. The most important part is how it defines the pre-project water situation, as a baseline by which to determine the improvements.

Topic 4. Importance of benefit estimation in costing. It would be better to look at the benefits generated by different design options. An example of a real-life questions : would you opt for a smaller rainwater tank for more households or a bigger one for fewer?

Topic 5. Glossary and translation into local languages would help accessibility – and some definitions need to be explained. Certain databases could be established as a basis for future work.

Unclear issues:
In the context of the economic evaluation, how do you treat land acquisition? And how do you deal with donations? Should survey costs of the economic evaluation be included? How do you account for water quality and option conveniences? Discount rates, shadow factors – and can abbreviations (AEC etc) be explain ed in simple language? And what is the useful life project cycle?

Group discussions on a follow up to the workshop , with an emphasis on capacity building

On Wednesday 31 October the country teams were asked to reflect on the follow up to the workshop, in particular to identify priorities in capacity building. Following is a transcript of the oral presentations by the country teams, and a summary of the Vietnamese PowerPoint presentation.

Cambodia
With respect to capacity building needs there had been a recent amendment to the budget plan for rural development. It is important to incorporate this method into the procedures. The Ministry of Rural Development (MRD) is de-centralizing to lower administrative levels and the Manual will need to be adapted for use at the community level (by communities or local NGOs).

Strengthening of arrangements between institutions is very important (governmental agencies and NGOs alike). The method should be brought to the consideration of the various institutions, at the monthly WATSAN meeting.

The policy framework for WSS already exists, and would be a good entry point for the consideration of economic aspects in the planning context. The technical working group on RWSS – in which several ministries have a seat - is a useful structure to promote the economic evaluation approach. The national strategy on water resources development and management is a third option to serve as a vehicle for the promotion of this approach.

Institutional arrangements in Cambodia are not very different from other countries – basically WSS and economic institutes should be working together, the EIC should take the lead in promoting the method.

Adaptation of the tool to the country context is essential. At the moment the tool is very generic yet with a lot of detail. Adaptation can make it more user-friendly.

For future human resources development, universities and engineering schools should join up in developing curricula that pull the two issues together

Indonesia
The national policy for drinking-water provides a multisectoral framework and the implementation of that policy is community-based. Indonesia can use the Manual once it is translated into the local language. A network exists between the various ministries, the planning bureau and universities. The case study has been brought to the attention of the members of this group and elicited great interest.

Lao PDR
The economic evaluation of WS options should be put in a Logical Framework. There is a need for internal strengthening of capacity in the Water Supply and Sanitation Centre, and an assessment should be made of the implications of adding economic evaluation to the existing plans.

As for training, questions remain who will train and what materials should be used.

Comparing with the older material *vs* the new concept of the water supply ladder and the sanitation ladder, it was felt that the purpose of the Manual had to be linked to these new concepts.

The two Lao case studies will be submitted to the relevant donors to explain to them the new approach that was applied.

A national workshop on the medium term would be foreseen, subject to donor interest. The two case studies are the pilots. As UNICEF is the main donor, their acceptance of this new concept is critical.

An additional point is that the need of the Planning authorities lies in this area of economic evaluation of WSS, and this should go beyond the cost analysis and take on board benefits analysis.

The Manual is very technical and therefore its translation in final form would be useful – then it has more value for training. In terms of the Lao Water Resources policy: this was developed many years ago and needs updating. In such a case economic evaluation should be inserted.

The new Water Resources and Environment Administration recently became responsible for WRD. There are several other institutions, ministries and committees involved. There have been discussions on focusing collaboration on monitoring of WSS. In this connection it has been recommended that a national committee be established.

The Ministry of Public Works/Water Treatment Authority also needs to be involved as they are responsible for urban water supply, including poor urban communities.

Philippines
Mainstreaming this tool and the capability to use it are key goals in the Philippines – it should be simplified, made more accessible and then it can be distributed widely. A web based version would accelerate that process. Translation is an important step for local acceptance.

Web-based experiences and examples would also strengthen the support for work done in the field. Rules of thumb are important in the way of thinking of engineers and should be included in the Manual.

Policies on economic evaluation in WS planning would support the mainstreaming. A small programme could be designed for a larger group of pilot communities to strengthen the evidence base for the value of this approach. Cost saving and sustainability would be convincing indicators for its use.

The extension to calculation of benefits would greatly enhance the potential of the Manual.

On the Government side it is clear that there is a range of institutions involved.
A meeting to introduce this method to them will be useful and then the use of this tool can be given a broader basis. The Dept of Health will be implementing the President's priority project on water supply as of 2009, so the regional health offices will need to adopt the economic evaluation approach and be trained in the use of the Manual/spreadsheets.

Policy-wise there are not many options to make a new policy out of this (or insert in existing policies) because further testing is needed first. There are several other agencies, e.g. the agencies setting the tariffs for drinking water, which can also use the procedure. There is also a window for the introduction of this component in the engineering curriculum of the University of the Philippines, which is already including water safety plans in its updated curriculum.

Thailand
It was suggested that the Thai follow-up would include mapping the organizations that are active in rural WSS and to see how they can be involved. A translation of a

summary of the Manual would then be the basis of a workshop at the national level. The various disciplines can then come together.

Once the engineers understand the economic concepts these criteria can be included in the decision-making on providing grants to communities for WS projects. There are ten regional offices in the Water Resources Department and a next step would be to have training for these staff. Other agencies can also be involved, especially at the planning level. There are no economists in the Bureau.

Involvement of the School of Engineering is also foreseen. The Government Sector for water was restructured five years ago and for budgeting funds go directly to the community – so technical staff function as consultants to communities.

The departmental focus is on water resources, and water supply is a subset of the activities. The policy framework for economic evaluation needs to be strengthened in the broader WRD policies.

Viet Nam
In terms of a policy framework: Viet Nam already has a policy framework because it has formulated a National Strategy and National Programme for rural water supply with very clear objectives:

This programme aims to achieve by 2010 that 80% of rural people have access safe water and 70% of rural households have access to hygienic latrines. It gives priority to poor people and minorities. By 2020 it aims for nearly 100% of rural people to have access to safe water for drinking and 100% of households to have access to hygienic latrines.

There also is an inter ministry circular between three ministries in Viet Nam: Ministry of Agriculture and rural development; Ministry of health and Ministry of Education and training

With respect to institution strengthening and arrangements, a steering committee has been established for rural water supply and environmental sanitation which includes 13 members from different ministries and organizations: Ministry of Agriculture and Rural Development; Ministry of Health; Ministry of Education and Training; Ministry of Planning and Investment; Ministry of Finance, others…

Based on functions of each involved ministry, a guideline is issued for implementation. There has the cooperation among the organizations during the process of implementation.

With respect to human resources development in Viet Nam, it is recommended:

a. to organize seminars/workshops to introduce the manual and set up some training course on the application of methodology to costing for consulting companies and/or implementing agencies at provincial level (Economic and Engineering).
b. cooperation with some institute in order to open seminar.
c. WHO support in publishing and distributing training materials to all countries.

d. To negotiate with other donors such as UNICEF and the World Bank in supporting all activities including document translation and publishing, training education.
e. Use the Vietnamese experience in establishing e-library of IEC and distributing materials on the Internet. Based on the materials, each province will use the materials in different ways in accordance with its condition.
f. Take advantage of E-learning as one useful manner to develop the capacity of staffs.
g. E&M system

= = =

3. CONCLUSIONS AND RECOMMENDATIONS

Fifteen participants from six countries in the WHO regions of South East Asia and the Western Pacific (Cambodia, Indonesia, Lao PDR, Philippines, Thailand and Viet Nam) met in Luang Prabang from 29 to 31 October 2008 to discuss the outcome of case studies applying a detailed costing method for improved drinking-water supply systems for low-income communities. The objectives were to discuss these results and the experience of using the Guidance document in diverse settings in their countries.

The group arrived at the following conclusions and recommendations:

(1) The case study experiences in the six countries, covering 13 water supply projects, have shown that the Manual on Costing Methods of Improved Drinking-water Systems for Low-income Communities, and the accompanying spreadsheets make up a valuable tool for the planning and design of WS projects.

(2) After further development of this tool, based on the outcome of the workshops and pilot projects, it can be readily mainstreamed in the planning and decision making procedures in all countries

(3) A number of constraints and obstacles were identified during the application of the Manual/spreadsheets, including a number of issues of definition and misunderstanding about concepts, but also a number of flaws in the spreadsheets that need further attention.

(4) It was also observed that the methods and approaches proposed require a multi-disciplinary team for their successful implementation, and that the creation of a partnership with economists and economic institutions is essential.

(5) All countries recognize the advantages of economic evaluation of drinking water supply options, accepting that technical characteristics often provide overriding arguments in favour of a certain option, but that within that option the different components can be subject to a cost analysis.

The following recommendations were adopted:

(1) Completion of the Manual and spreadsheets based on the findings of the case studies and the workshop discussions, and their distribution in final form to all participants (together with a CD ROM of the workshop proceedings.

(2) Expansion of the methodology to social benefits analysis, and strengthening the rationale for doing it, including screening criteria to decide when it is appropriate to do a full SCBA.

(3) Exploration of options to translate the Manual into local languages and to derive from the Manual appropriate training materials.

(4) Completion of the country case study reports, by the country teams, based on the discussions in Luang Prabang, and submission of the final updated reports by 15 December 2008.

(5) In follow up to the workshop, assist countries in developing capacity building plans in this area, with relevance to policy, institutional and human resource strengthening and in line with national needs.

(6) Consider the establishment of a database with case study material that can be consulted for future reference and in support of costing methods.

Post script:

In response to these recommendations, the authors of the Practical Manual took the following action:

Four additions were made to the spreadsheets in order to improve their user-friendliness:

1. A glossary of the technical terms used in the spreadsheet with a reference page to the Manual for more detailed explanations. This glossary appears when the user selects an item of the spreadsheet to introduce the requested information in the appropriate cell.

2. A tool to model the annual growth of the production indicators of the WS system when the level of services provided by the WS system varies in time. This tool computes a time trend of the indicator using different trend curves (constant, linear, logistic, exponential, negative exponential, etc.) calibrated according to three parameters:
    a. Initial level of WS system production,
    b. Projected level of WS system production,
    c. Number of years to reach the projected level.

    To measure the level of services of the WS system we suggest using three indicators:
    a. The number of household connections,
    b. The average household's size,
    c. The average per capita water consumption in m^3 per year.

    These indicators allow computing a unit cost per household, per inhabitant and per m^3 water consumption.

3. Introduction of two kinds of error messages:
    a. Compulsory input,
    b. Unreliable input.

4. The possibility to input directly the cost data to a disaggregated or to an aggregated item level.

ANNEXES

Annex 1
Programme of work for second workshop
Costing of improved water supply systems for low-income communities
Luang Prabang, 29-31 October 2008

Wednesday 29 October 2008

09:00 Opening of the workshop
Statements on behalf of Nam Saat (National Centre for Drinking-water and Sanitation,
Lao PDR), the University of Geneva, the US Department of State and the WHO,

Introduction of participants.

09:30 Objectives and expected outputs
Review of the outcome of the first workshop and follow-up action

Robert Bos, WHO/PHE

10:00 USAID/RDMA Water and Sanitation Programs in Asia

Mr Saengroaj Srisawaskraisorn, USAID/Asia

10:30-11:00 Refreshments

11:00 Presentation country case studies with possibility for immediate questions

11:00-11:45 Cambodia
11:45-12:30 Lao PDR

12:30-14:00 Lunch

14:00 Presentation country case studies with possibility for immediate questions (continued)

14:00-14:45 Philippines
14:45-15:30 Thailand

15:30-16:00 Refreshments

16:00 Presentation country case studies with possibility for immediate questions (continued)

16:00-16:45 Viet Nam
16:45-17:30 Indonesia

Thursday 30 October 2008

09:00 Recapitulation of day 1, Q&A

Robert Bos, WHO/PHE

09:15-10:30 Group work to discuss lessons learned and questions remaining from the case studies.

10:30-11:00 Refreshments

11:00-12:00 Presentation of group work case studies

Plenary discussion with presentations by the two groups

12:00-13:30 Lunch

13:30 Presentation country experiences using the Manual -
evaluation reports with a discussant from one of the other countries

13:30-14:00 Viet Nam (discussant Cambodia)
14:00-14:30 Thailand (discussant Indonesia)
14:30-15:00 Philippines (discussant Lao PDR)
15:00-15:30 Lao PDR (discussant Philippines)

15:30-16:00 Refreshments

16:00 Presentation country experiences using the Manual -
evaluation reports with a discussant from one of the other countries (continued)

16:00-16:30 Indonesia (discussant Thailand)
16:30-17:00 Cambodia (discussant (Viet Nam)

17:00-17:30 Plenary discussion on generic issues coming out of the evaluation

Friday 31 October 2008
09:00 Recapitulation of day 1, Q&A

Robert Bos, WHO/PHE

09:15-10:00 Presentation on the Manual for the Cost-Benefit Analysis of Sanitation Options

Professor Fabrizio Carlevaro, Dr Cristian Gonzalez
University of Geneva

10:00-10:30 Presentation on the Global Annual Assessment of Sanitation and Drinking-water

Robert Bos, WHO/PHE

10:30 refreshments

10: 45-11:30 Discussion of the spread sheets

Dr Cristian Gonzalez
University of Geneva

11:30 Follow-up to the workshop: country interventions on policy framework, institutional arrangements and human resources development (training and skills development)

Plenary session

12:15 lunch

13:30 Follow-up to the workshop: country interventions on policy framework, institutional arrangements and human resources development (continued)

Plenary session

14:00 Closing session, review of conclusions and recommendations for the final report.
14:30 Closure of the workshop

Annex 2.
Final List of Participants
Second inter-regional workshop on costing methods of improved drinking-water systems for low-income communities
Luang Prabang, Lao PDR 29-31 October 2008

Country participants

Cambodia

	**Mr Seiha Neou** Senior Researcher Economic Development Program Economic Institute of Cambodia #234 Phnom Penh Centre Corner Street 274& 3 Tonle Bassac, Phnom Penh, Cambodia Tel.: + 855 23 987941 Fax: +855 23 224626 Mobile: +855 12 668003 E-mail: seiha.neou@eicambodia.org
	**Mr Seng Eam Hor** Deputy Director of Rural Water Supply Ministry of Rural Development Phnom Penh, Cambodia Corner Street # 169 and Russian Boulevard Phnom Penh, Kingdom of Cambodia Tel.: +855 23 357 676 Fax: +855 23 357 676 Mobile: +855 129 187 49 E-mail : eamhor@yahoo.com

Indonesia

	**Mrs Dra Pimanih M.Kes** Head of CPMU Direktorat Jenderal PP&PL Gd. Konsultan Lt. II Jl.Percetakan Negara No. 29 Jakarta Pusat Indonesia Tel.: +6221 426 1490 Fax: +6221 428 87466 E-mail : cpmu_cwshp@cbn.net.id

	**Mr Donal Simanjuntak** Water Sanitation Sub Directorate Staff Directorate EH-DG, Ministry of Health Indonesia Jl. Percetakan Negara No.29 Samlemba, Jakarta, Indonesia Tel.: +6221 727 7608 ext 127 E-mail : don_jtk@yahoo.com
	**Mr Mara Karma, Akt.** Accounting and Auditing Specialist Water Sanitation Sub Directorate Staff Community Water Services and Health Project Directorate EH, Ministry of Health Jl. Percetakan Negara No.29 Samlemba, Jakarta, Indonesia Tel.: +62 21 727 7608 E-mail : mara.karma@gmail.com

Lao PDR

	**Dr Soutsakhone Chanthaphone** Deputy Director National Centre for Environmental Health and Water Supply Ministry of Health P.O. Box 1225 Vientiane, Lao PDR Tel/Fax: +856 21 413310 E-mail : soutch@laotel.com
	**Mr.Somvang Bouttavong** Acting Director, Dept Environmental and Social Impacts Assessment Center for Infrastructure and Public Investment Projects Water Resources and Environment Administration Prime Minister's Office P.O. Box 7864 Vientiane Capital, Lao PDR Tel: +856-21-241744 ; Tel./Fax: +856-21-218737 Mobile : 246 83 83 E-mail : somvangb@gmail.com

	**Dr. Saykham Voladeth** Senior Technical Officer National Economic Research Institute Ministry of Planning and Investment Vientiane capital, Lao PDR Tel/Fax: +856 21 711181 Mobile: +856 20 2845246 E-mail: saykhamv@yahoo.com

Lao PDR
(local participants)

	**Mr Anoulak Khamphilom** Technical staff Water Supply Division Nam Saat Central Vientiane Lao PDR
	**Mr.Khamphuthai Sitthilath** Technical Staff Water Supply Division Nam Saat Central Vientiane Lao PDR

The Philippines

Mr Joselito Riego de Dios

Chief Health Program Officer
National Center for Disease Prevention & Control
Environmental and Occupational Health Office
Department of Health
San Lazaro Hospital Compound
Sta. Cruz, Manila
Philippines
Tel/Fax: +632 732 9964

E-mail : litoriego@yahoo.com

Mr José Carmelo Gendrano

Water and Sanitation Engineer/Research Officer
Philippine Center for Water and Sanitation – ITN Foundation
P-3 Minnesota Mansions
267 Ermin Garcia Street
Cubao,Quezon City
Philippines 1102
Tel/Fax: +63 2 9120531

E-mail: bojig@yahoo.com

Mr Apolonio Jimenez

Water and Sanitation Engineer
Philippine Center for Water and Sanitation-ITN Foundation
P-3 Minnesota Mansions
267 Ermin Garcia Street
Cubao, Quezon City , Philippines 1102
Tel/Fax: +63 2 9120531

E-mail: apoloniojimenez@yahoo.com

Thailand

Mr. Teerayut Udomporn

CDSEA Researcher
Faculty of Environment and Resource Studies
Mahasarakham University
Mahasarakham 44150 Thailand
Tel/Fax: +66 43 742135

E-mail : u_teerayut@yahoo.com

Ms. Janya Trairat

Thailand Water Resource Association (TWRA)
Department of Water Resources
180/3 Praram 6 Road, Soi 34,
Sasennai, Payathai
Bangkok 10400 Thailand
Tel.: +66 2 271 6000
Fax: +66 2 271 3667

E-mail : janya@rocketmail.com

Viet Nam

Mrs Ha Thanh Hang, MSc

Vice-Director,
National Center for Rural Water Supply and Sanitation (NCERWASS)
73 Nguyen Hong Str., Dong Da,
Hanoi, Viet Nam
Tel.: +84 4 8355823 Fax: +84 4 7760439
Mobile: +84 913 314 997

E-mail: hathanhhang@cerwass.org.vn

Ms Nguyen Thuy Linh

Science and Technology Section
National Center for Rural Water Supply and Sanitation (NCERWASS)
73 Nguyen Hong Str., Dong Da,
Hanoi, Viet Nam
Tel.: +84 4 8355823 Fax: +84 4 776 0439
Mobile: +84 988425925

E-mail: smallcake2411@yahoo.com

University of Geneva: Department of Econometrics

Professor Fabrizio Carlevaro

Département d'économétrie
UNI MAIL
Boulevard du Pont d'Arve 40
CH-1211 Genève 4
Tel. : +41 22 379 8223
Fax: +41 22 379 8299

E-mail : Fabrizio.Carlevaro@metri.unige.ch

Dr Cristian Gonzalez

Département d'économétrie
UNI MAIL
c/o Fabrizio Carlevaro
Boulevard du Pont d'Arve 40
CH-1211 Genève 4
Tel.: +41 22 379 8223
Fax: +41 22 379 8299
E-mail : cristian.unige@gmail.com

WSP-Cambodia

Mr Phyrum Kov

Water Supply and Sanitation Analyst
Water & Sanitation Program - Cambodia
113 Norodom Boulevard
Phnom Penh, Cambodia
Tel.: +855 23 217304
Fax: +855 23 210373

E-mail: pkov@worldbank.org

World Health Organization

Mr Robert Bos

World Health Organization
Department Public Health and Environment (PHE)
Avenue Appia 20
1211 Geneva 27, Switzerland
Tel.: +41 22 791 3555
Fax: +41 22 791 4159

Email: bosr@who.int

	**Mr Khamkha Boudboonheuang** Environmental Health Officer WHO Office Lao PDR 125 Saphanthong Road unit 5 Ban Saphanthongtai, Sisattanak district PO Box 343 Vientiane Capital, Lao PDR Tel.: +856 20 6903764 E-mail: boudboonheuangK@wpro.who.int
	**Mr Saengroaj Srisawaskraisorn** Regional Program Development Specialist USAID / Asia, Regional Environment Office GPF Witthayu Tower A, 10th floor 93/I Wireless Road Bangkok 10330 Thailand Tel.: +66 2 263 7464 Fax: +66 2 263 7499 E-mail ssrisawas@usaid.gov
	**Mr Daniel Wilusz** Foreign Affairs Officer Office of International Health and Biodefense Bureau of Oceans, Environment and Science US Department of State Washington DC USA Tel.: +1 202 647 6817 Fax: +1 202 736 7336 (fax) Email: WiluszDC@state.gov

Unable to attend

	**Dr Mohd Nasir Hassan** Environmental Engineer World Health Organization WPRO WHO Cambodia and Lao PDR Office Tel.: +855 12 905 565 E-mail : hassanm@wpro.who.int
No picture	**Dr Guy Hutton** Senior Water and Sanitation Economist Water & Sanitation Program - East 113 Norodom Boulevard Phnom Penh, Cambodia Tel.: +855 23 217304 Fax: +855 23 210373 Mobile: +855 12 590734 Email: ghutton@worldbank.org
	**Mr Ton Tuan Nghia** Programme Officer, Water and Sanitation WHO Vietnam Office Tel.: +844 0912 048 370 E-mail : nghton@yahoo.com, tontuann@wpro.who.int
	**Dr Mao Saray** Deputy Director of Rural Water Supply Ministry of Rural Development Phnom Penh, Cambodia Corner Street # 169 and Russian Boulevard Phnom Penh, Kingdom of Cambodia Tel.: +855 23 357 676 Fax: +855 23 357 676 Mobile: +855 125 585 58 E-mail : maosaray@online.com.kh
	**Dr Adisak Sattam** National Professional Officer (Monitoring and Evaluation) WHO Country Office for Thailand Tel.: +66 2 590 1524 Fax: +66 2 591 8199; E-mail: adisak@searo.who.int

	**Ms. Pitchaya Somkliang** Researcher Thailand Environment Institute (TEI) 16/151 Muang Thong Thani, Bond Street, Bangpood, Pakkred, Nonthaburi 11120 Thailand Tel.: +66 2 503 3333 Fax: +66 2 504 4826-8 E-mail : pitchaya_somkliang@hotmail.com, pitchaya@tei.or.th
	**Mr. Le Thieu Son** Deputy Director Department of Water Resources, Ministry of Agriculture and Rural Development. Head of Standing Office of NTP II 2 Ngoc Ha Str., Ba Dinh Ha Noi, Viet Nam Tel.: +84 4 7347099 Fax: +84 4 733 5702 Mobile: 84 982345853 E-mail: sonlt.tl@mard.gov.vn