



# Training Manual for Lao Integrated Water Resources Management

December 2015







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National Integrated Water Resources Management

Support Program - Capacity Building

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Supported by



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# Abbreviations

<b>ADB</b>	Asian Development Bank	<b>MEM</b>	Ministry of Energy and Mines
<b>AFD</b>	Agence Francaise de Development	<b>MIWRM</b>	Mekong Integrated Water Resources Management
<b>AusAid</b>	Australian Aid	<b>MONRE</b>	Ministry of Natural Resources and Environment
<b>CDTA</b>	Capacity Development Technical Assistance	<b>MPI</b>	Ministry of Planning and Investment
<b>CSO</b>	Civil Society Organization	<b>MRC</b>	Mekong River Commission
<b>CTA</b>	Chief Technical Advisor	<b>MRCs</b>	Mekong River Commission Secretariat
<b>DMH</b>	Department of Meteorology and Hydrology	<b>NIWRMSP</b>	National Integrated Water Resources Management Support Program
<b>DONRE</b>	District Office of Natural Resources and Environment	<b>NN</b>	Nam Ngum
<b>DPC</b>	Department of Planning and Cooperation	<b>NNRB</b>	Nam Ngum River Basin
<b>DWR</b>	Department of Water Resources	<b>NNRBC</b>	Nam Ngum River Basin Committee
<b>EA</b>	Executing Agency	<b>NNRBCS</b>	Nam Ngum River Basin Committee Secretariat
<b>EIA</b>	Environmental Impact Assessment	<b>NNT2</b>	Nam Theun 2
<b>EMSP</b>	Environmental Management Support Program	<b>NRBMTF</b>	Nam Ngum River Basin Management Task Force
<b>GIS</b>	Geographic Information System	<b>NREI</b>	Natural Resources and Environment Institute
<b>GOL</b>	Government of Lao PDR	<b>NT-NKD</b>	Nam Thuan Nam Krading
<b>IFC</b>	International Finance Corporation	<b>NTPC</b>	Nam Theun 2 Power Company
<b>IWMI</b>	International Water Resources Management Institute	<b>NUOL</b>	National University of Laos
<b>IWRM</b>	Integrated Water Resources Management	<b>PCM</b>	Project Cycle Management
<b>IRBM</b>	Integrated River Basin Management	<b>PIU</b>	Project Implementation Unit (one for each IA)
<b>KKU</b>	Khon Khaen University	<b>PMU</b>	Program Management Unit
<b>KFW</b>	German Development Bank Group	<b>PONRE</b>	Provincial Office of Natural Resources and Environment
<b>LAO PDR</b>	Lao People's Democratic Republic	<b>QPR</b>	Quarterly Progress Report
<b>LMB</b>	Lower Mekong Basin	<b>RBC</b>	River Basin Committee
<b>LNMC</b>	Lao National Mekong Committee	<b>RBCS</b>	River Basin Committee Secretariat
<b>LFA</b>	Logical Framework Analysis	<b>RBM</b>	River Basin Management
<b>MAF</b>	Ministry of Agriculture and Forestry		

<b>RBO</b>	River Basin Organization
<b>SEA</b>	Strategic Environmental Assessment
<b>SIA</b>	Social Impact Assessment
<b>SWOT</b>	Strengths, Weaknesses, Opportunities and Threats
<b>TA</b>	Technical Assistance
<b>TAF</b>	The Asia Foundation
<b>TNA</b>	Training Needs Assessment
<b>TOR</b>	Terms of Reference
<b>TWG</b>	Technical Working Group
<b>WB</b>	World Bank
<b>WERI</b>	Water and Environment Research Institute
<b>WWF</b>	World Wide Fund for Nature
<b>WREA</b>	Water Resource and Environment Administration

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Special thanks to Mr. Bounsamong Fongnaly, the Director of Awareness Building and Training Center of DWR and the Manager of the Component 1 of National IWRM Support Program (TA-7780) who is behind all the training arrangements and is one of the principal trainers. In addition, we would like to thank the Consultant Package 1 Team from AECOM Asia Company Limited who led the technical designs and facilitated most training programs, and compiled this

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# Background



The Ministry of Natural Resources and Environment (MONRE) led by the Department of Water Resources (DWR) is the Project Executing Agency (EA) of the National Integrated Water Resources Management Support Program (hereafter NIWRMSP or “the Program”). The implementation of the Program commenced in October 2011 will end at the end of 3rd quarter of 2015, approximately after four years. The Program has four components, which are Component 1: National Capacity Building in Integrated Water Resources Management, Component 2: River Basin Management Development, Component 3: National Groundwater Action Plan Preparation, and Component 4: Integrated Water Resources Management Education Strengthening at the National University of Lao PDR. All of the four components are designed to directly assist MONRE in implementing the National Water Resource Management Strategy and Action Plan 2010-2015, and to complement and coordinate other IWRM capacity building activities/projects funded by other development partners that are outside the scope of ADB TA. The outputs of the TA aim to support MONRE to settling itself in the center of coordination and facilitation of sustainable integrated water resources management (IWRM) at national, provincial, district, local and basin levels.

The key outputs of the Component 1: National Capacity Building in Integrated Water Resources Management is to deliver trainings and capacity building programs in IWRM from basic to highly technical areas and issues,

for different target groups in MONRE’s departments from national, provincial, district and local levels, water related agencies in other different ministries, river basin organizations and National University of Lao PDR. The main outcomes of the deliveries of these training and capacity building program are that necessary human resources and strengthened institutional capacity of the target agencies and organizations - in which at least eight specific areas of capacity building outcomes are identified and elucidated as:

- 1. Leadership:** MONRE’s leadership to be widely recognized by Lao PDR institutions as a reference Center of Competence for Water and Water related Natural Resources Management;
- 2. Institutional Development:** The mandates, duties and “day by day” activities of MONRE Departments and River Basin Committee Secretariat (RBCS) to be consistent with IWRM principles, Water Law and Environmental Law.
- 3. Water Law Implementation:** The new Water Law shall be clearly understood by MONRE’s Departments. The respectively concerned MONRE’s Departments shall have the necessary legal framework (Decrees, Agreements, Guidelines, etc.) and the institutional capability (Mandates, Duties, day by day organization rules and clarification) to proceed to its implementation in terms of public dissemination, monitoring and enforcement.

**4. Knowledge:** Through efficient collaboration between its sector departments, MONRE shall have the capacity to develop and maintain sound integrated knowledge of water and water related natural resources to provide decision support for river basin profile development and planning, ecosystems protection, SIA and EIA, and climate change resilience.

**5. Human Resources:** MONRE Departments and RBCs staff shall have good overall understanding of the IWRM framework and new Water Law. The staff shall be specifically trained on IWRM topics that they need for achieving their specific tasks.

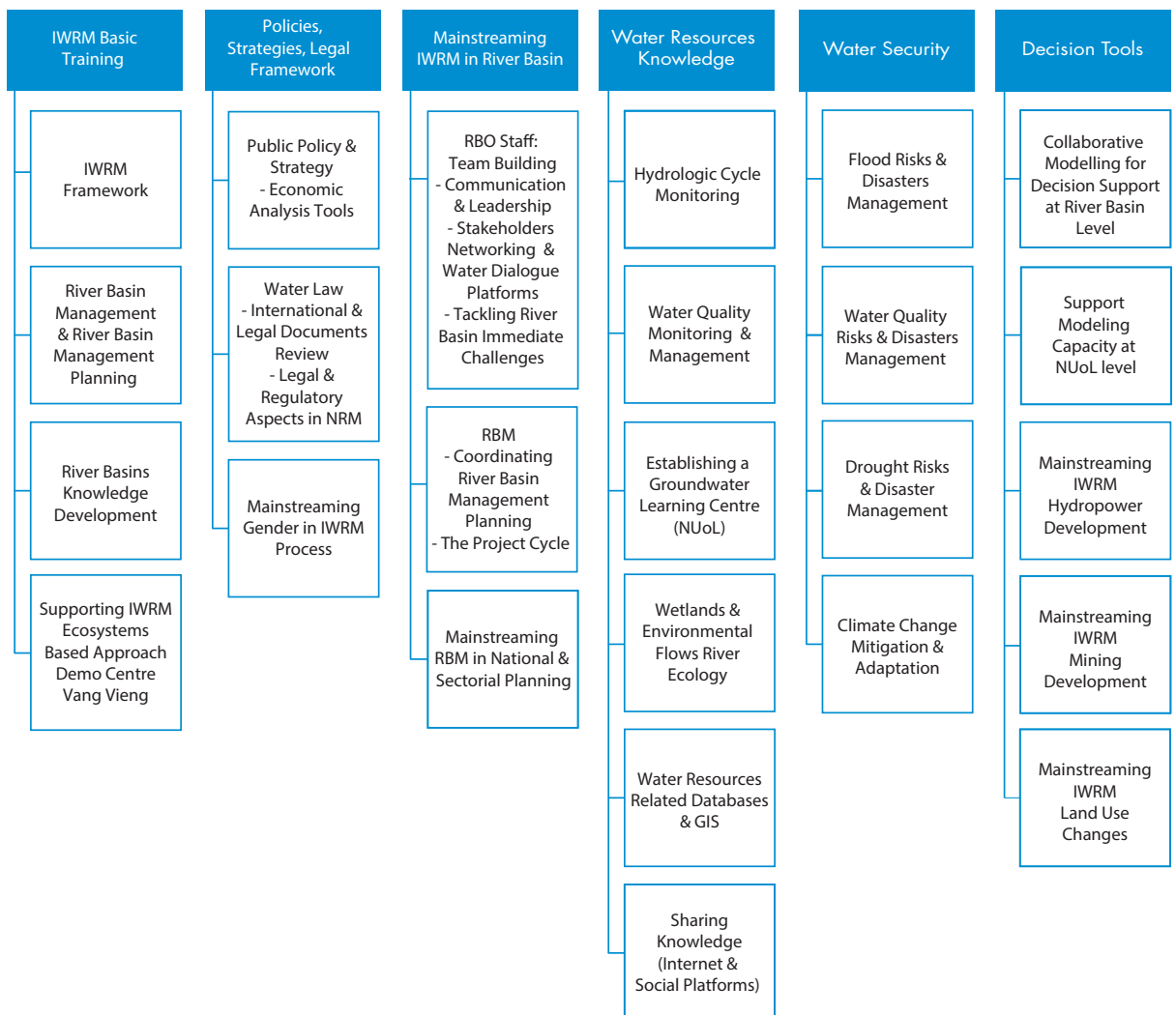
**6. Internal Communication:** "Team Building" process and proactive communication instructions, guidelines and tools are developed for allowing efficient cooperation and transparent sharing of Information and data on water and water related natural resources between MONRE's Departments.

**7. IWRM Community Based And Participation:** MONRE, with focus on its Provincial and Districts Branch Offices), shall have the institutional capacity and knowledge to support IWRM community based and stakeholders participation processes and projects.

**8. Facilities:** Facilities, test equipment and tools shall be available and provided when needed for supporting Capacity Development Outputs.

The MONRE's IWRM Training Needs Assessment (TNA) and MONRE's IWRM Training Plan were prepared. The Training Plan was revised in late 2013 include at least key six IWRM disciplinary areas and 24 different training courses, which are essential for the identified target groups. The IWRM disciplinary areas and courses are listed in the Training Plan Organization Chart below.

**Figure 1: Training Plan Organization Chart**







As of December 2015, there have been 22 training workshops implemented, covering at least 10 training courses. The training workshops were organized to target different groups, including total of 966 individuals (i.e. 256 women and 720 men) across Lao PDR at national, provincial, district and community levels.

The topics that are covered in the Training Manual of this TA are as follows:

1. IWRM Framework
2. Integrated River Basin Management and River Basin Management Planning
3. River Basin Knowledge Development
4. Supporting IWRM and Community Engagement Pilot Project
5. Flood Risks and Disaster Management
6. Project Cycle Management
7. Groundwater Management
8. Collaborative Modelling
9. Water Quality Management



# Introduction to the Training Manual

The main objective of the Training Manual is to compile the information on available key resource materials in IWRM focusing specifically for Lao PDR, and for reference uses of governmental staff, NGOs, practitioners, researchers, as well as for open public. In addition, the Training Manual is also used to record and monitor the trainees who have participated in the MONRE IWRM's training program facilitated by DWR. The record is to be used for long-term monitoring purposes for IWRM capacity building effort by MONRE.

Most the training have been conducted as on-the-job based trainings. The training module is designed to support governmental staff and institutions to better understand the critical water issues at national, basin and local levels, as well as to understand each other's roles and responsibilities in managing the water issues. The training is designed to increase their own professional capacity and to build cross-agency and multi-disciplinary team-work to tackling and solving water issues which the last is the heart of IWRM.

For each of the training topic, the training manual consists of five main parts which include:

1. Fact sheet on tracking records the training that includes all necessary information such as name of the training, training date and venue, methodologies, target groups, training evaluation results and recommendations for next steps. The evaluation of each training course was made at the end of the training by the trainees. The trainer team handed an evaluation form to the trainees to evaluate and rate the training by scores and written recommendations on each training sessions and the whole training course.
2. Situation analysis and training concepts that provide information and rationale of the training synthesized by international standard principles and theories, and Lao national and local case studies. Recommendations for follow-up actions are also elucidated in the last section of the concept.
3. Agenda of each of the training topic was developed on the foundation of training modules recommended by the situation analysis and concept note. The agenda of the training that was implemented is included so it can serve as an example or a model agenda that could be easily adopted by the MONRE's trainer team upon future training programs.
4. Training Materials, which include keynote presentations, reference documents, and recommended public short films, are provided. All of the listed files are also available for download at <http://www.riversweb.org/monreCBP>.
5. List of participants and trainees is also included as part of the Annex.

# **Training Manual for Integrated Water Resources Management (IWRM) Framework**



# I. Fact Sheet

Name of training course:	<b>Integrated Water Resources Management (IWRM) Framework</b>
Level and specialty:	Basic and on-the-job based training
After the training, the trainees will:	<ol style="list-style-type: none"><li>1. Gain and well understand pragmatic IWRM key messages that fit with the specificities of the Lao context that would be built interactively.</li><li>2. Build a "Team Spirit" among the participants from across different water relevant sectors but within the same basins.</li><li>3. Develop guidelines helping to fine tune the Training Plan and coordination and communication activities.</li></ol>
Target groups:	<ul style="list-style-type: none"><li>• Governmental water agencies and staff at central, provincial, district and sub-district levels.</li><li>• River basin organizations</li><li>• National University of Laos</li></ul>
Number of training days:	4.5 days per training
Dates and venue of training:	<p>This training was conducted three times in different parts of Laos, targeting stakeholders in the region of focus.</p> <ol style="list-style-type: none"><li>1. For central region, 3-7 February 2014</li><li>2. For southern region, 21-25 July 2014</li><li>3. For northern region, 8-12 December 2014</li></ol>
Number of trainees:	<ol style="list-style-type: none"><li>1. Central region, 47 trainees (8 women and 39 men)</li><li>2. Southern region, 53 trainees (17 women and 36 men)</li><li>3. Northern region, 59 trainees (14 women and 45 men)</li></ol>
List of trainees:	See Annex A-1
List of principal trainers:	<p>Mr. Bousanong Fongnaly, Training and Awareness Building Unit Director, Department of Water Resources</p> <p>Mr. Eric Tilman, International IWRM Capacity Building Specialist</p> <p>Mr. Suparerak Janprasart, Chief Technical Advisor and Team Leader</p>
Training methodologies:	<p>The training was divided into three different sessions, in which different methodologies were applied.</p> <ul style="list-style-type: none"><li>• Keynote presentations and interactive discussions prepared by the trainees themselves</li><li>• Keynote presentations and interactive discussions prepared and facilitated by trainers</li><li>• Field trip and field exercise in stakeholder interviews</li><li>• Small group exercises</li><li>• Plenary presentations on the analysis of the local water issues that they have found and recommendations on the next steps</li></ul>

#### Training materials:

1. Situation Analysis, Training Concepts and Training Modules
2. Training Program Agenda with Training Methodologies
3. Keynote Presentations

#### Recommended additional reference materials:

1. Existing and new draft National Lao Water Law
2. MONRE 's Decrees and Mandates
3. IWRM Guidelines at River Basin Level  
<http://unesdoc.unesco.org/images/0018/001864/186417e.pdf>
4. What is IWRM? Global Water Partnership  
<http://www.gwp.org/The-Challenge/What-is-IWRM>

#### Training assessment results and findings:

**I. IWRM Framework Training for Central Region** was conducted in Vang Vieng District, Vientiane Province. The training was regarded as an introductory course of IWRM principles; to update IWRM knowledge for Laos and team building for MONRE, PONRE and DONRE staffs, RBC and partner agencies. Most of which trainees were from the central part of Laos. The score and feedback of this training given by the trainees was surprisingly positive. The average score was **8.5/10**.

It was reported by the trainees by the end of the training that this training was the very first time ever that gave them an opportunity to meet and work with many experts from diverse water fields - and on over the water issues within their own basin and district. Many of which desired to participate in this type of training again but in different in-depth water areas in the future. They also offered a few key recommendations and proposed initiatives that would bring forward to the next steps of training based on the foundation built by this training such as a development of IWRM-ecosystem based demonstration site, and participatory water monitoring for youth group in Vang Vieng.

**II. IWRM Framework Training for Southern Region** was organized in Champasak Province. The training introduced key principles of IWRM, tools and regional best practice as well as to encourage the trainees to present and discuss their own water management issues at national and basin scales. The training focused the trainee audience in southern part of Laos. The training modules included keynote discussion, introduction of principles, tools and concept, study tour field trip and on-the-job group exercises.

IWRM concepts and practices than that the trainees in the central part. The study tour and field trip encouraged the trainees to better understand key water issues at regional and basin scales. They learned from the training that the growing competition of water demands between mono-crop agriculture, urbanization, industry and hydropower sectors in southern Laos has been becoming rather serious but however, yet to become recognized by many. The trainees proposed DWR to organize another on-the-job training series in multi-stakeholder platform for water planning for Champasak and Attapeu Provinces in order to discuss the facing challenge of such water demand competition. The trainees scored this training **7.5 out of 10**.

Training assessment results and findings:

**III. IWRM Framework Training for Northern Region** was held in Luang Namtha Province. Objectives of the training were similar to that held for the central and southern regions. The slight differences were the applications and examples from local context and training approach. The average score was among the highest than other trainings which was **9 out of 10**.

Due to the difficulties in communication, limited transportation options and limited national budgeting, the trainees in northern part of Lao PDR were among the most remote groups. However, the issues in water management in the northern region are perhaps among the most critical. A number of hydropower and large scale land use projects are being planned and have already been developed. These hydropower projects are however implemented in the absence of local participation, reliable social data and unknown impacts. The capacity of government staff at all levels is also limited to limited. The trainees highly appreciated the trainer team that traveled a long way for the training and this is shown through the proactive participation of the trainees. Team building was one of the most successful aspects of the training by far, and the training was able to successfully build fundamental knowledge in IWRM principles, tools, as well as provide an thorough understand on technical communication in water management.

Next steps and Recommendations:

1. A pilot project in IWRM-ecosystem-based approach should be considered at least one per region.
2. Organize the similar training once a year with the same trainee group as to update their local water situation and monitor progress of their water management skills, and to strengthen team building.
3. Additional trainings in different water topics and capacity building programs should be considered, particularly for the trainee groups in the northern region.



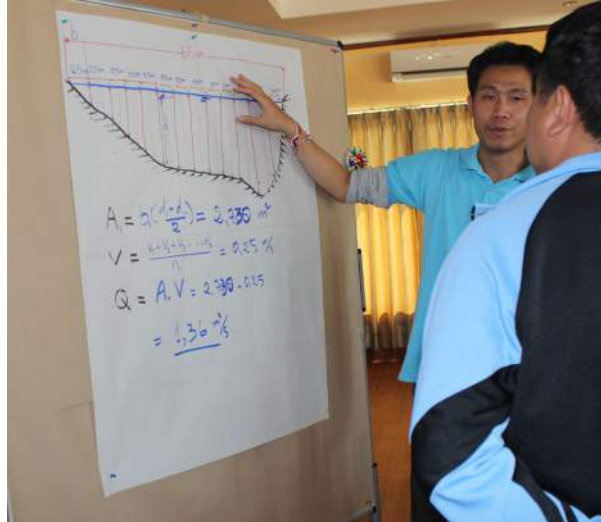
## II. Situation Analysis, Training Concepts and Training Modules

### A. Justification

Integrated Water Resources Management (IWRM) is a process which promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment. IWRM helps to protect the world's environment, foster economic growth and sustainable agricultural development, promote democratic participation in governance, and improve human health. Worldwide, water policy and management are beginning to reflect the fundamentally interconnected nature of hydrological resources, and IWRM is emerging as an accepted alternative to the sector-by-sector, top-down management style that has dominated in the past<sup>1</sup>.

Many Manuals and Guidelines have been written to help mainstreaming IWRM in multi-sector investments and planning exercises. One of these manuals that was already tested in several Asian River Basin is the "IWRM Guidelines at River Basin Level" from UNESCO-NARBO<sup>2</sup>. This document explains very well the IWRM Spiral and Process to be applied for River Basin management. Several case-studies illustrate how to put the theory into practice. On a regional level, it is important to mention the document "Manual for Training Trainers in Integrated Water Resources Management in the Mekong Basin"<sup>3</sup> carried out by MRC.

IWRM is now recognized as the basic strategy for managing Water Resources in Lao PDR and tests in Pilot River Basins and Watersheds are now at different stage of development. But even if general guidelines are now quite well developed and understood, the



implementation remains subject to many constraints that are specific and that need tailor-made approaches. It is why implementing IWRM in Lao PDR, as in any other country world-wide, is an actual complex challenge made of success and failure stories.

This training refers to the Course N° 11 in the Training Plan under the name "Legal Framework for IWRM". Nevertheless, the concept developed in this document enlarges substantially the Legal Framework to cover the other core aspects of IWRM. In such a way, this Training will be relevant to all NIWRMSP staff of the different components that are involved in the various disciplines of water resources management. As it will be the first training to be organized, it is important, in addition to specific IWRM skills, to deliver enhancement of Team Building spirit and bases for further staff networking.

The next figure allows to localize this module within the framework of the Training Plan:

1. [Global Water Partnership: What is IWRM - http://www.gwp.org/The-Challenge/What-is-IWRM](http://www.gwp.org/The-Challenge/What-is-IWRM)

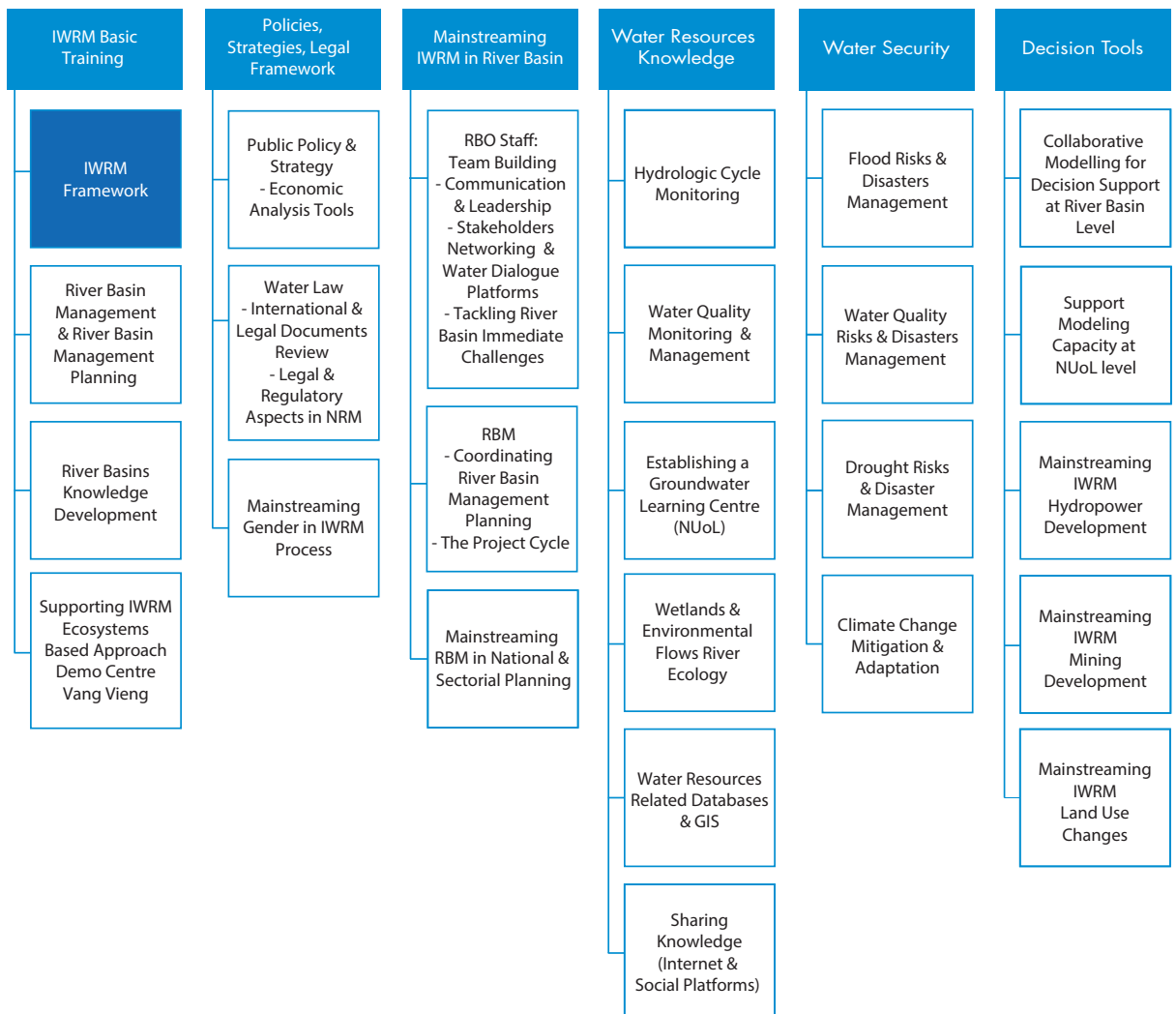
2. <http://unesdoc.unesco.org/images/0018/001864/186417e.pdf>

3. <http://www.mrcmekong.org/assets/Other-Documents/BDP/BBDP2-MRCS-IWRM-Training-Manual-2011.pdf>





**Figure 2: Training Plan Organization Chart**





## B. Expected Outputs

The expected outputs are:

- **Pragmatic IWRM Key Messages, that fit with the specificities of the Lao context that would be built interactively with the Trainees:** The Training on “IWRM Framework” is expected to develop and reinforce capacities of the Trainees for passing from IWRM Theories to Practical Implementation in Lao PDR and its river basins and watersheds. Coming out with recognized Key Messages is expected to create “Water Leadership” capacities.
- **Building a “Team Spirit” among the participants:** This training module is an opportunity to bring the NIWRMSP staffs together and enhance Team Building amongst the participants. The training on “IWRM Framework” will meet a wide range of staff, dealing with different disciplines related to water resources management, around the table. This would be an actual asset for better achievement of coordination and communication among NIWRMSP components.
- **Provide guidelines helping to fine tune the Training Plan and coordination and communication activities.**

## C. Main Topics Covered

The training will focus on two key concepts of IWRM:

- Develop relevant Water Governance Tools which include:
  - Legal and Institutional Tools (water law, water policies, water strategies)
  - Water Dialogue Tools (river basin and watershed organizations, stakeholders, information sharing, awareness, etc.)
  - Decision Tools (Data and Information gathering, analysis, models, etc.)
- Develop step-wise process for mainstreaming IWRM in Basin and River Management (basin and watershed profile, developing a vision, road map, action plans, impacts monitoring, etc.)

## D. Methodology

As many or either a few participants have already a sound knowledge of IWRM principles and practical experience in implementation, the training will be more oriented on developing analysis of the relevance, strengths (success stories) and constraints (failure

stories) referring to the respective core areas defined here above. Group discussions must allow interactivity between staff from different disciplines, help building Key Messages that fit with the Lao specificities, support Team Building and eventually enhance Water Leadership capacities. The methodological tools will be as follows:

1. **Keynotes:** In order to set up a common language amongst the participants and share knowledge and progress regarding NIWRMSP components, keynotes will be presented on these Lao case studies framing on IWRM Key Concepts for facilitating further discussions.
2. **Discussion Groups:** Discussion Groups will be set up for analyzing the relevance, strength and weakness of the IWRM areas in the context of water resource management in Lao PDR.
3. **Role Play:** Simulation of a River Basin Organization-Water Dialogue meeting where the participants will have to represent the different stakeholders, represent their interests and try to find a fair tradeoff. The starting point of the role play would be virtual watershed, but having similar issues to what is generally featured in Lao PDR. The starting point of the role play would be a short watershed profile document. The participants would develop Issues and Trends, Shared Vision, elements of Road Map.
4. **Field Visit:** A field visit to a watershed will be organized. Different elements of IWRM implementation will be reviewed by the Trainees and the Watershed stakeholders. IF the training is organized in Vientiane City, it is suggested to visit Nam Ton watershed, which is not part of NIWRMSP activities, but in which significant progress have been done for IWRM development (water resources monitoring, land and water use planning, water dialogue at different levels (villages, sectors, private investors), inter-provinces/districts collaboration.
5. **Wrap Up Panel:** By the end of the training, the participants would be invited to wrap up what they have cached up from the training (via a questionnaire). Key Messages, evaluation and advises for further training and capacity building steps will be delivered by a group of panelists.

It is also suggested that participants develop key messages and policy recommendations on water management in Lao PDR in different topics and present to the high level representatives at the end of the Training. This should be a highlight of this Training course. Specific topics will be dialogued and determined during the training.

## E. Modules

Modules	Brief Content	Program
<b>Module1: IWRM Governance Tools</b>	1.1 Keynotes IWRM setting the scene - water governance tools	Upgrading the IWRM concept, critical lessons learnt and turning point of IWRM implementation globally and regionally. <ul style="list-style-type: none"> <li>IWRM tools (institutional, dialogue, decision); At what milestones Lao PDR has reached?</li> <li>Areas for SWOT - evaluation matrix - benchmarking progress</li> </ul>
	1.2 Working groups (presentations and debates)  Water governance tools SWOT analysis & benchmarking	Working groups (presentations and debates): IWRM tools – strengths and weaknesses analysis based on evaluation matrix and group/plenary discussions  <b>WG1: Institutional Tools (water law, strategy, policy)</b> Presentation of case studies <ol style="list-style-type: none"> <li>Draft water law, Q&amp;A</li> <li>Nam Ngum River Basin, Q&amp;A</li> </ol> Group work and debate - Critical analysis on strengths and weaknesses
		<b>WG2: Decision Tools (data and information systems, sharing information, data &amp; information analysis &amp; models)</b> Presentation of case studies <ol style="list-style-type: none"> <li>EIA/SIA</li> <li>Modeling and scenarios</li> </ol> Group work and debate – Critical analysis on strengths and weaknesses  <b>WG 3: Dialogue Tools (mapping stakeholders, organizing stakeholders meeting, information &amp; knowledge sharing, awareness, communications, formal and informal dialogue)</b> Presentation of case studies <ol style="list-style-type: none"> <li>MRC BDP basin planning</li> <li>A case study from non-state group</li> </ol> Group work and debate – Critical analysis on strengths and weaknesses

Modules	Brief Content	Program
<b>Module 2: IRBM Mainstreaming IWRM Process in Planning Cycles</b>	2.1 Keynotes IWRM setting the scene – IWRM cyclic step-wise process	What is/are river basin planning(s)? How do they work? <ul style="list-style-type: none"> <li>• Basin-watersheds profile</li> <li>• Issues and trends</li> <li>• Vision</li> <li>• Road map</li> <li>• Action plans</li> <li>• Monitoring and analysis of impacts</li> </ul>
	2.2 Role play Mainstreaming IWRM in the planning cycle – “How can we work together? Where are the roles of DWR at?”	Working group(s) <ul style="list-style-type: none"> <li>• Developing case studies by using existing cases of river basin management in Laos i.e. Nam Ngum, Xe Bang Hien, Nam Thuan Krading and Sedone,</li> <li>• Simulate how RBO, Watershed Committees, Water Dialogues Platform can support the IWRM process (role play)</li> <li>• Critical analysis on strengths and weaknesses and debates</li> </ul>
<b>Module 3: Field Visit</b>	3.1 Field visit	<ul style="list-style-type: none"> <li>• Water dialogue process</li> <li>• Participation in river basin management</li> <li>• Water monitoring (surface water, groundwater, water quality)</li> </ul>
	3.2 Working group evaluation	<ul style="list-style-type: none"> <li>• Strengths and weaknesses of this case study</li> </ul>
<b>Module 4: Wrapping Up and Evaluation</b>	4.1 Working groups	Wrapping up – writing key messages on IWRM framework <ul style="list-style-type: none"> <li>• WG 1: Water Governance Tools</li> <li>• WG 2: Mainstreaming IWRM</li> <li>• WG 3: Team Building: Further steps (communications, website, on line training, etc.)</li> </ul>
	4.2 Group presentation to high level and plenary dialogue	<ul style="list-style-type: none"> <li>• Water policy recommendations for Lao PDR</li> <li>• Highlight lessons learnt from the training</li> </ul>
	4.2 Keynotes Wrapping up of M1 To M3	<ul style="list-style-type: none"> <li>• Ways forward</li> </ul>
	4.3 Evaluation	<ul style="list-style-type: none"> <li>• Evaluation questionnaire and analysis</li> </ul>

# III. Training Program Agenda

## Day 1

Time	Program	Resource Person
8:00-8:30	Registration	Admin
8:30-8:45	Opening remarks	DG of DWR
8:45-9:00	Introduction and objectives of the training	Training Unit Director
<p><b>Session 1: Governance Tools: Evolution of IWRM and Current IWRM Settings in Lao PDR</b></p> <p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>To Update and upgrade the IWRM concept, critical lessons learnt and turning points of IWRM implementation globally, regionally and Laos</li> </ul> <p><b>Methodologies:</b></p> <ul style="list-style-type: none"> <li>Presentations</li> <li>Interactive plenary discussions</li> </ul>		
9:00-9:30	Upgrading IWRM concept and reviews of critical lessons learnt from international through national cases Presentation and plenary dialogue <i>Keynote presentation 1 (English)</i>	International IWRM Specialist Facilitator
9:30-10:15	Institutional Planning and Settings of IWRM in Lao PDR at the Current State Presentation and plenary discussion <i>Keynote presentation 2 (Lao)</i>	Planning Division Facilitator
10:15-10:30	Coffee Break	
10:30-12:00	Laos Water Law and Legal Structures Presentation and plenary discussions – comments on the new draft law, standard structure of law <i>Keynote presentation 3 (Lao)</i>	River Basin Component and law division Facilitator
12:00-13:00	Lunch	
14:00-14:15	Team building exercise/game	Facilitator

Time	Program	Resource Person
<b>Session 2: Integrated River Basin Management Mainstreaming IWRM Process in Planning Cycle</b> <b>Objectives:</b> <ul style="list-style-type: none"> <li>To introduce and get familiarized with IWRM Approaches and Tools (i.e. Institutional, Dialogue, Decision); At what milestones Lao PDR has reached?</li> <li>Areas for SWOT – Evaluation matrix – benchmarking progress</li> </ul> <b>Methodologies:</b> <ul style="list-style-type: none"> <li>Presentations</li> <li>Interactive plenary discussions</li> </ul>		
14:15-16:30	Integrated River Basin Management Nam Ngum River Basin Strategies and Action Plan Presentations and Q&A; group exercises and plenary presentations <i>Keynote presentation 4 (English)</i>	International IWRM Training Specialist NNRBCS Group facilitators
15:15-15:30	Coffee break	
18:30	Dinner	



## Day 2

Time	Program	Resource Person
8:30-9:00	Recap from day 1 and evaluation	Facilitator
<p><b>Session 3: Field Visit and Group Exercise</b></p> <p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>To introduce and make familiarized of simple and rapid field survey in different disciplinary areas</li> </ul> <p><b>Methodologies:</b></p> <ul style="list-style-type: none"> <li>Role play</li> <li>Field surveys, stakeholder interviews</li> <li>Small group exercises</li> </ul>		
9:00-12:00	<p>Introduction of role play field exercise; Integrated River Basin Survey and Planning, and Environmental/Social Impact Assessment</p> <ul style="list-style-type: none"> <li>Introduction of rapid assessment methodologies</li> <li>Rapid livelihood/social survey</li> <li>Rapid water quality monitoring</li> <li>Rapid river cross section monitoring</li> <li>Rapid ground water monitoring</li> <li>Testing of field equipment i.e. GPS, water monitoring tool kit, cross sector tool kit and ground water monitoring tool kit</li> </ul> <p><i>*Participants will be divided into five groups. Every group member within each group will be assigned to play a role of selected disciplinary expert such as social expert, hydrologist, ground water specialist, and biologist. They will participatory conduct river basin planning and impact assessment exercises.</i></p> <p>The role-play experts are required to collect data and key development issues at the field and provide critical expert opinions according to their selected discipline. The collected data will be compiled and assessed for sustainable river basin planning and impact assessment exercises. Their findings will be presented and dialogued in Day 4.</p> <p>Q&amp;A</p>	<p>Trainee teams</p> <p>Facilitator</p>
10:00-10:30	Coffee Break	
10:30-12:00	<p>Laos Water Law and Legal Structures</p> <p>Presentation and plenary discussions – comments on the new draft law, standard structure of law</p> <p><i>Keynote presentation 3 (Lao)</i></p>	<p>River Basin Component and Law Division</p> <p>Facilitator</p>

Time	Program	Resource Person
12:00-13:00	Lunch	
13:00-13:30	Travel to Nam Poa, approx. 20 mins from the training facilities	Logistics team
14:00-14:30	Re-testing of field equipment and the groups select their own sub-basin (sub-tributaries of the Nam Mong)	Trainee team
14:30-16:30	Introduction of the river basin by the head of the villager Dialogue and Q&A	Trainee team Facilitator
16:30	Travel back to facilities	
18:30	Dinner	

### Day 3

Time	Program	Resource Person
8:00-8:30	Recap from day 2 and evaluation	Facilitator
8:30-9:30	Refreshing data collection survey and integrated planning methodologies Introduction of dialogue and participation tools Dialogue, Q&A	Trainee teams CTA Facilitator
9:30-10:00	Travel back to the field – and coffee break provided in the shuttle bus	Logistics team
10:00-12:00	Conduct field exercises	Training team and group facilitators
12:00-13:00	Lunch at the field	
13:00-16:30	Continue field exercises; group work exercises, multi-disciplinary planning and impact assessment	Training team and group facilitators
16:30-17:00	Travel back to facilities	Logistics team
18:30	Dinner	



## Day 4

Time	Program	Resource Person
8:00-9:00	Recap from day 3 and evaluation	Facilitator
<p><b>Session 4: Wrapping up and Evaluation</b></p> <p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>• To analyze data and issues, and share the result of the field surveys to plenary</li> <li>• To collaboratively plan for next steps towards the found water resources issues</li> </ul> <p><b>Methodologies</b></p> <ul style="list-style-type: none"> <li>• Small group exercises</li> <li>• Interactive discussions</li> <li>• River basin management planning exercise</li> </ul>		
8:30-12:00	Group presentations River basin planning dialogues and impact assessment – plenary exercises	Group facilitators
12:00-13:00	Lunch	
13:00-16:30	Planning exercise <ul style="list-style-type: none"> <li>• Identify priorities</li> <li>• Identify stakeholders and target groups and area based</li> <li>• Identify strength and weaknesses in human capacity, institutional capacity and legal framework, financial capacity, and enabling environment</li> <li>• Step by step planning with timeframes</li> </ul>	Facilitator

## Day 5

Time	Program	Resource Person
8:00-10:30	Recap from day 4 Group presentations on finding issues and water resources planning	Trainee teams
10:30-10:30	Coffee break	
10:30-11:30	Course evaluation	CTA
11:30	Travel back	

# IV. Training Materials

## Keynote presentation 1: IWRM Principles and Topics for Training Plan and Capacity Building (English)

# IWRM Principles and Topics for Training Plan and Capacity Building

NIWRMSP Building Capacity: Package 1  
Training : IWRM Framework

Eric Tilman  
International Consultant  
[www.riversnetwork.org](http://www.riversnetwork.org)

1

### About water resources ... The Facts

- Global water: 97% seawater, 3% freshwater. Of the freshwater 87% not accessible, 13% accessible (0.4% of total)
- Today more than 2 billion people are affected by water shortages in over 40 countries
- 263 river basins are shared by two or more nations
- 2 million tonnes per day of human waste are deposited in water courses
- Half the population of the developing world are exposed to polluted sources of water that increase disease incidence
- 90% of natural disasters in the 1990s were water related.
- The increase in numbers of people from 6 billion to 9 billion will be the main driver of water resources management for the next 50 years

Source : Cop-Net: <http://www.cop-net.org/>

2

### About water resources : The key issues

<p><b>Water governance crisis</b> Sectoral approaches to water resources, management have diminished in the past and are still prevailing. This leads to fragmented and uncoordinated</p>	<p><b>Increased competition</b> Increased competition for the finite resource is aggravated by inefficient governance.</p>	<p><b>Securing water for people</b> Over 60% of the world's population is without access to safe drinking water and half of the population is without access to adequate sanitation.</p>	<p><b>Securing water for food production</b> Over the next 25 years food will be required for another 2-3 billion people. Water is increasingly seen as a key constraint on food production...</p>	<p><b>Protecting vital ecosystems</b> Aquatic ecosystems depend on water flows, quantity and water table fluctuations and are threatened by poor water quality. Land and water resources management must ensure that vital ecosystems are maintained.</p>
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Source : Cop-Net: <http://www.cop-net.org/>

3

## Keynote presentation 2: Laos Water Resources Management and Planning (Lao)



ຝຶກອົບຮົມ ກ່ຽວກັບການຄຸ້ມຄອງຊັບພະຍາກອນນໍ້າ ແບບປະສົມປະສານ  
ຄັ້ງວັນທີ 03-07 ມັງກອນ 2014, ທີ່ເມືອງວັງຈຽງ ແຂວງວຽງຈັນ

# ຂະບວນການວາງແຜນ ໃນການຄຸ້ມຄອງຊັບພະຍາກອນນໍ້າ

ນໍາສະເໜີໂດຍ: ພະແນກບໍລິຫານ-ແຜນການ  
ກົມຊັບພະຍາກອນນໍ້າ, ກຊສ


### ການວາງແຜນແມ່ນຫຍັງ?

ການວາງແຜນ ໝາຍເຖິງ ການກຳນົດ ສະພາບ ຫຼື ສະຖານະພາບ ທີ່ ຄາດວ່າຈະເກີດຂຶ້ນ ໃນອະນາຄົດ ເຊິ່ງມີ ການວາງແນວທາງປະຕິບັດ ເພື່ອໃຫ້ບັນລຸ ຕາມຈຸດປະສົງທີ່ ຕັ້ງໄວ້

### ແຜນງານແມ່ນຫຍັງ?


ແຜນງານ ໝາຍເຖິງກຸ່ມໂຄງການ ທີ່ກ່ຽວຂ້ອງ ແລະ ປະສານ ກັນ ຕັ້ງແຕ່ 2 ໂຄງການຂຶ້ນໄປ, ມີການດຳເນີນງານ ທີ່ ສອດຄ່ອງ ກ້ຽວພັນກັນ ເພື່ອທີ່ຈະບັນລຸຈຸດປະສົງ ແລະ ເປົ້າ ໝາຍທີ່ຕ້ອງການ.

## Keynote presentation 3: Lao Related Water Law and Decrees (Lao)



ສະພາບໂດຍລວມ ຂອງ ກົດໝາຍ ວ່າດ້ວຍ ນ້ຳ ແລະ ຊັບພະຍາກອນແຫຼ່ງນ້ຳ

- ກົດໝາຍວ່າດ້ວຍນ້ຳ ແລະ ຊັບພະຍາກອນແຫຼ່ງນ້ຳ ຮັບຮອງປີ 1996 ແລະ ດຳລັດ ຈັດຕັ້ງປະຕິບັດ ຮັບຮອງ ປີ 2001.
- ກົດໝາຍວ່າດ້ວຍນ້ຳ ແລະ ຊັບພະຍາກອນແຫຼ່ງນ້ຳປະກອບດ້ວຍ 10 ໝວດ ແລະ 49 ມາດຕາ
- ກຳນົດຫຼັກການ ໃນການຄຸ້ມຄອງນ້ຳ ມີລັກສະນະກວ້າງຂວາງ, ສະຫຼັບຊັບຊ້ອນ ແລະ ການກຳນົດຄວາມຮັບຜິດຊອບ ໃນການຄຸ້ມຄອງ ຊັບພະຍາກອນນ້ຳ ຢູ່ພາຍໃຕ້ຫຼາຍກະຊວງ.



ການຈັດຕັ້ງປະຕິບັດ ກົດໝາຍ ວ່າດ້ວຍ ນ້ຳ ແລະ ຊັບພະຍາກອນແຫຼ່ງນ້ຳ

- ກົດໝາຍຍັງບໍ່ທັນຕອບສະໜອງໄດ້ ຕາມຄວາມຮຽກຮ້ອງຕ້ອງການ ໃນການຈັດຕັ້ງປະຕິບັດ ການຄຸ້ມຄອງນ້ຳແບບຄົບຊຸດ ແລະ ມີປະສິດທິພາບ ເຊັ່ນ:
  - ການສຳຫຼວດ, ຂຶ້ນບັນຊີແຫຼ່ງນ້ຳ ແລະ ການກຳນົດປະເພດແຫຼ່ງນ້ຳ ແລະ ອ່າງຮັບນ້ຳ
  - ການນຳໃຊ້ນ້ຳ ແລະ ຊັບພະຍາກອນແຫຼ່ງນ້ຳ
  - ການພັດທະນາແຫຼ່ງນ້ຳ ແລະ ການຄຸ້ມຄອງ ກິດຈະການ ພັດທະນາແຫຼ່ງນ້ຳ: (ຜົນປະກອບສ່ວນ ໃນການປົກປັກຮັກສາແຫຼ່ງນ້ຳ)
  - ການປັກຮັກສານ້ຳ ແລະ ຊັບພະຍາກອນແຫຼ່ງນ້ຳ: (ມາດຕະຖານຄຸນນະພາບນ້ຳ)
- ບໍ່ທັນສາມາດ ຮ່າງພົດທຸກລະບຽບການ ເພື່ອຈັດຕັ້ງປະຕິບັດ ກົດ ໝາຍ ນ້ຳ ໄດ້.

ນິຕິກຳ ກ່ຽວຂ້ອງກັບຊັບພະຍາກອນນ້ຳ

- ໃນປັດຈຸບັນການຄຸ້ມຄອງຊັບພະຍາກອນນ້ຳ ໄດ້ມີຫຼາຍນິຕິກຳ ຫຼື ຫຼາຍກົດໝາຍ ທີ່ກ່ຽວຂ້ອງ ດັ່ງນີ້:
  1. ກົດໝາຍວ່າດ້ວຍ ການປົກປັກຮັກສາສິ່ງແວດລ້ອມ
  2. ກົດໝາຍວ່າດ້ວຍ ສີ່ດິນ
  3. ກົດໝາຍວ່າດ້ວຍ ປ່າໄມ້
  4. ກົດໝາຍວ່າດ້ວຍ ການທ່ອງທ່ຽວ
  5. ກົດໝາຍວ່າດ້ວຍ ຊົນລະປະທານ
  6. ກົດໝາຍວ່າດ້ວຍ ນ້ຳປະປາ
  7. ກົດໝາຍວ່າດ້ວຍ ແຮງທາດ
  8. ກົດໝາຍວ່າດ້ວຍ ບໍ່ແຮ່
  9. ກົດໝາຍວ່າດ້ວຍ ກະສິກຳ
  10. ກົດໝາຍວ່າດ້ວຍ ໄຟຟ້າ



## Keynote presentation 4: Introduction of Integrated River Basin Management (English)

# INTRODUCTION OF RIVER BASIN MANAGEMENT

NIWRMSP Building Capacity:  
Package 1  
Training : River Basin Management



Eric Tilman  
International Consultant  
[www.riversnetwork.org](http://www.riversnetwork.org)

### SOME DEFINITION



River Basin



Watershed



Wetlands

### IDENTIFY AND RECOGNIZE SPECIFICITIES ... EVERY BASIN IS DIFFERENT

Whether the basin is within one country or several countries;

The scale of planning and management (transboundary, national, local);

The stage of development in the basin, for example as regards the economy, infrastructure;

The stage of development of the basin management organisation;

The main water management challenges, for example population pressure, sanitation, food production, health, flood and drought protection, and

The social, economic, political and institutional environment.

# **Training Manual for Integrated River Basin Management and River Basin Management Planning**



# I. Fact Sheet

Name of training course:	<b>Integrated River Basin Management and River Basin Management Planning</b>
Level and specialty:	Basic and on-the-job based training
After the training, the trainees will:	<ol style="list-style-type: none"><li>1. Understand the concepts, key approaches and tools of integrated river basin management (IRBM) and planning.</li><li>2. Have extensively shared, dialogued and learnt of critical experiences, challenges, and key issues in IRBM and planning.</li><li>3. Have the capacity to adopt those concepts and tools for a design of planning, facilitating and monitoring of IRBM project, as well as for their own current projects.</li><li>4. Have strengthened team work skills.</li></ol>
Target groups:	<p>This training was specifically designed to target trainees located in Nam Thuan and Xaybangfai Basins and with the primary objective to support the World Bank Mekong IWRM Project – Xaybangfai Flood Management Component.</p> <p>The trainees include:</p> <ul style="list-style-type: none"><li>• Governmental water agencies and staff at central, provincial, district and sub-district levels;</li><li>• River basin organizations;</li><li>• National University of Laos;</li><li>• Hydropower operators and</li><li>• Local communities and impacted groups.</li></ul>
Number of training days:	4.5 days per training
Dates and venue of training:	This training was conducted in Thakhek District, Khammouane Province, Nam Thuan and Xaybangfai Basin on 26-30 May 2014
Number of trainees:	51 Trainees (12 women and 39 men)
List of trainees:	See Annex A-2
List of principal trainers:	<p>Mr. Bounsamong Fongnaly, Training and Awareness Building Unit Director, Department of Water Resources</p> <p>Mr. Eric Tilman, International IWRM Specialist</p> <p>Mr. Suparerk Janprasart, Chief Technical Advisor and Team Leader</p>



#### Training methodologies:

The training was divided into six different sessions, and different methodologies were used. The methodologies employed include:

- Keynote presentations and interactive discussions prepared by the trainees themselves
- Keynote presentations and interactive discussions prepared and facilitated by trainers
- In-depth study tour of Nam Thuan 2 Hydropower
- Field trip and field exercise in local stakeholder interviews
- Small group exercises
- Plenary presentations on the analysis of the local water issues that they have found and recommendations on the next steps

#### Training materials:

1. Situation Analysis, Training Concept and Training Modules
2. Training Program Agenda with Training Methodologies
3. Keynote Presentations
4. Short Documentary Film

#### Recommended additional reference materials:

1. River Basin Planning Principles, Procedures and Approaches for Strategic Basin Planning  
<http://www.adb.org/publications/river-basin-planning-principles>
2. From Local Watershed Management to Integrated River Basin Management at National and Transboundary Levels  
<http://www.mrcmekong.org/assets/Publications/Reports/Watershed-Management-report2011.pdf>
3. Evaluation of Environmental Impacts Assessment in Lao PDR
4. Draft - Lao National River Basin Atlas, 2015, Department of Water Resources



Training assessment results and findings:

**Integrated River Basin Management and River Basin Planning Training**

successfully achieved all the four training objectives despite the fact that most trainees have rather limited background in IRBM skills prior to the training. The average training assessment score was given **8/10**.

It was found in the very first day of the training that many trainees were not familiar with IRBM/IWRM concept and had limited capacity in technical communication and critical water issues within their basins. Most of the trainees have never experienced such training nor they have participated in this type of training. Thus, the trainees appreciated the effort given by trainer team. The trainees also highly appreciated the field trip and on-the-job training exercises, in which helped them to better understand their roles and responsibilities, to understand how to use the team work approach to solve conflicts and most importantly to understand the challenging situation in water resource management within their own basins and region. As part of the training, the trainees had the opportunity to visit of Nam Thuan 2 Hydropower and have had extensive dialogues with NNT2 Hydropower experts. The trainees also went to visit and interview affected communities in the Xaybangfai basins in order to learn about benefits and impacts resulting from the hydropower development as well as other associated issues, such as deforestation and climate change.

Once the trainees had learned and gained confidence about IRBM principles and critical water issues in the basins, which include flash floods, soil erosion and poor water quality. Towards the end of the training, the trainees proposed to DWR for further technical assistance to facilitate a stakeholder platform between NT2 Hydropower Operators, MONRE and Xaybangfai communities in order to discuss on the EIA/SIA, the benefits distribution and impact mitigation measurement for Xaybangfai local communities.

Next steps and Recommendations:

- Additional trainings in flood management, stakeholder platform facilitation and SIA/EIA.
- Organize the similar training once a year with the same trainee group as to update their local water situation and monitor progress of their water management skills, and to strengthen team building.

## II. Situation Analysis, Training Concepts and Training Modules

### A. Justification

Managing River Basins and Watersheds is one of the IWRM areas. Integrated river basin management (IRBM) may be defined as the process of coordinating conservation, management and development of water, land and related resources across sectors within a given river basin, in order to maximize the economic and social benefits derived from water resources in an equitable manner while preserving and, where necessary, restoring freshwater ecosystems<sup>4</sup>.

The key elements to a successful IRBM initiative are<sup>5</sup>:

- A long-term vision for the river basin, agreed to by all the major stakeholders.
- Integration of policies, decisions and costs across sectoral interests such as industry, agriculture, urban development, navigation, fisheries management and conservation, including through poverty reduction strategies.
- Strategic decision-making at the river basin scale, which guides actions at sub-basin or local levels.
- Effective timing, taking advantage of opportunities as they arise while working within a strategic framework.
- Active participation by all relevant stakeholders in well-informed and transparent planning and decision-making.
- Adequate investment by governments, the private sector, and civil society organizations in capacity for river basin planning and participation processes.
- A solid foundation of knowledge of the river basin and the natural and socio-economic forces that influence it.

There are actually many ways for building IRBM that have been experimented worldwide<sup>6</sup>. Conducting IRBM is generally understood as a spiral process;

each cycle of the spiral comprising several steps. It is expected that the next cycle of the spiral will be better managed than the previous one, after evaluation and lessons learned. The key steps are globally as follows: (i) establishing a river basin profile and mapping the stakeholders; (ii) develop water dialogue amongst the stakeholders for identifying issues and opportunities and developing shared vision; (iii) together with the stakeholders, develop a road map with short, middle and long term strategies; (iv) from the road map, develop actions plans that will be mainstreamed into the socio-economic development plan at different level (national, provincial and district) or that may be part of the legal framework; (v) monitor and evaluate the implementation of the actions plans which will be an entry for updating each of the steps during the next cycle. A cycle may reasonably cover a period of 5 years.

The experience world-wide shows that the most important key of success is the strong commitment of all the actors (institutional, private, NGOs, and Civil Society) at all stage of the process. Coordinating this commitment among the stakeholders is sometimes called "Water Dialogue", which is actually a concept already utilized in Lao PDR and in the Mekong region<sup>7</sup>.

It is generally admitted that it is necessary to have an institutional body for maintaining this dialogue and establishing rules for making it transparent, fair and constructive. This support is sometimes called RBO, but there is many other naming such as River Basin Authority, River Basin Initiative, etc. The role and functions, as well as the members and the way of functioning may be very different from a country to another<sup>8</sup>. This last point is important for Lao PDR because there is still serious questioning in relation with the concept of "RBO" and "Watersheds Committees", their role, functions and memberships.

4. Adapted from Integrated Water Resources Management, Global Water Partnership Technical Advisory Committee Background Papers, No. 4, 2000.)

5. WWF: [http://wwf.panda.org/about\\_our\\_earth/about\\_freshwater/river/irbm](http://wwf.panda.org/about_our_earth/about_freshwater/river/irbm)

6. Several examples are shown in the website [riversnetwork.org](http://www.riversnetwork.org) under this reference: <http://www.riversnetwork.org/rbo/index.php/component/k2/itemlist/tag/Basins%20%20Watersheds%20Management%20Plan>

7. See Mekong Water Dialogue: [http://www.iucn.org/about/union/secretariat/offices/asia/regional\\_activities/mekong\\_water\\_dialogues\\_mwd](http://www.iucn.org/about/union/secretariat/offices/asia/regional_activities/mekong_water_dialogues_mwd)

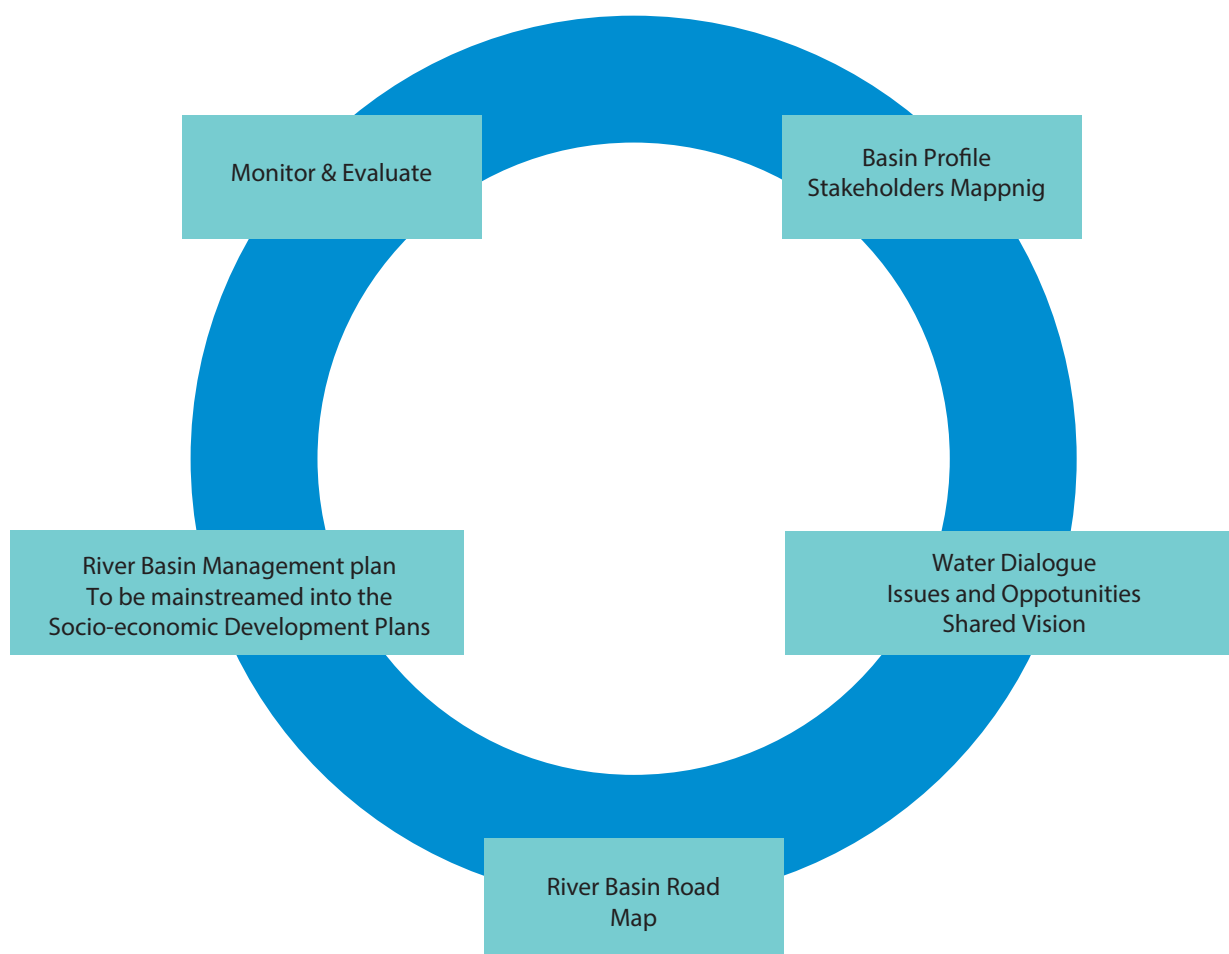
8. Numerous example of such organizations are shown in [riversnetwork.org](http://www.riversnetwork.org) under the reference: <http://www.riversnetwork.org/rbo/index.php/component/k2/itemlist/tag/Basins%20%20Watersheds%20Organisations>

By the end, and referring to the definition given in the 1st paragraph, the role of the institution leading the RBM process (in our case MONRE/DWR) is mainly a role of:

- Coordination of the different steps of the IRBM cycle
- Coordination of the water dialogue process
- Support for the institutional design and the implementation of the related organization where this dialogue will be maintained and where the RBM coordination may be developed (RBO or any other name)
- Monitor the river basin status, ensure a sufficient level of knowledge (River Basin Profile) and develop tools for sharing these information amongst the stakeholders.

IRBM is actually the 3rd statement of the Lao National Water Resources Policies “Integrated water resource management plans are prepared in priority in river basins, sub-basins and groundwater aquifers”. In this context, Lao PDR has started the implementation of several related projects, mainly with the support ADB (Component 2) and WB (Component 3.1). Actually, IRBM is one of the key tasks actually developed at MONRE/DWR levels. As a consequence, several Professional staff have got already extended skills and experiences in this topic. It is why, it will be important to get this staff involved in the training preparation and implementation as resource persons.

**Figure 3: Integrated River Basin Management Cycle**



Lao PDR is nearly entirely comprised in the Mekong River Basin. Within this framework, Mekong Basin Development Plans have been drafted. It is therefore important, as part of the training, to frame the River Basin Management in Lao PDR into the Lower Mekong Basin (LMB) context. In addition, at national level and in a context of decentralization, managing river basins that are shared between provinces and districts is also challenging. Both may refer to trans-boundary river basin management, which means that additional levels of multi-stakeholders collaboration, based on administrative and national boundaries, must be considered.

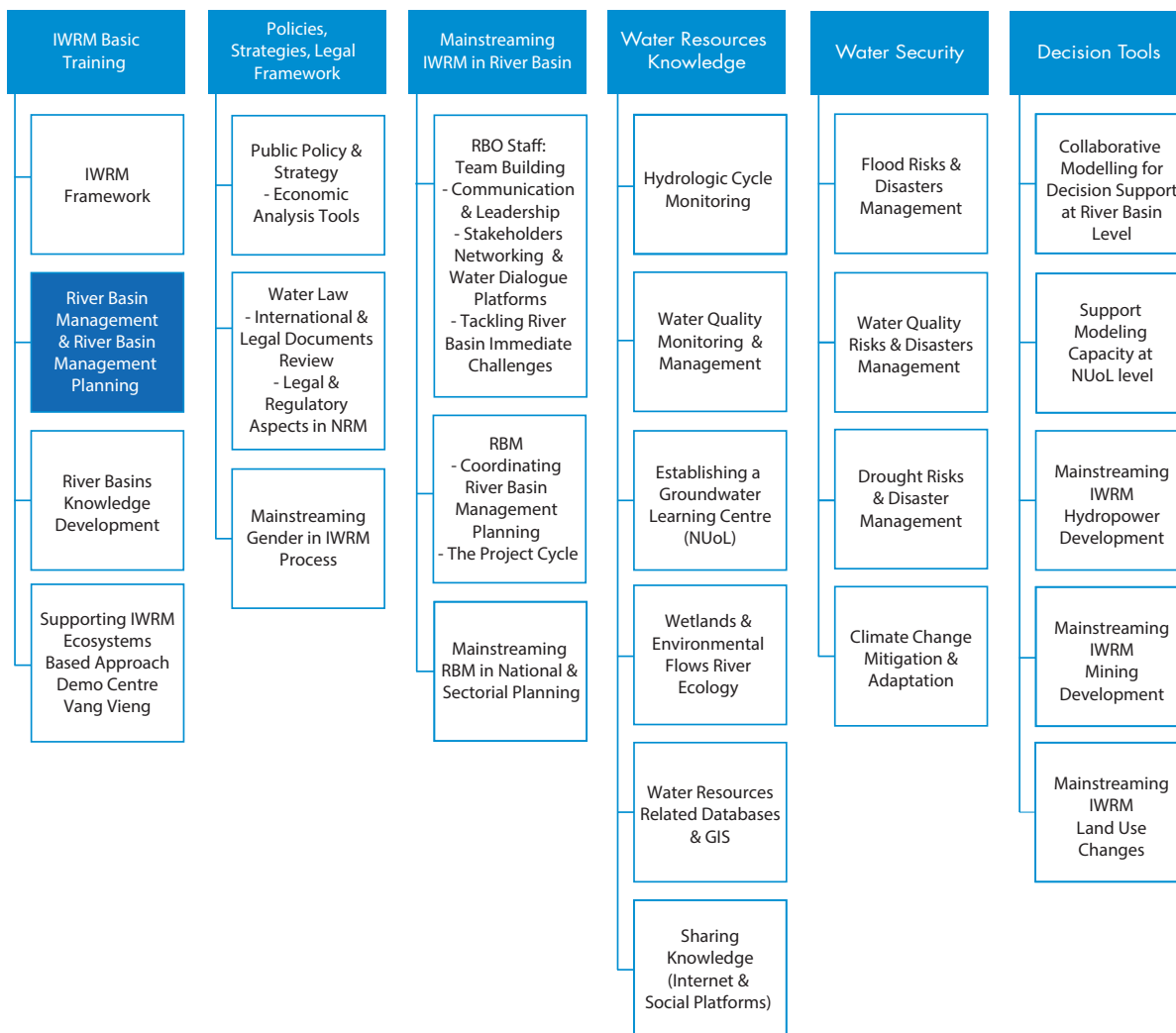
Actually, trans-boundary management is adding new challenges in comparison with basin being entirely comprised in one administrative unit. The challenge are essentially (i) to extent the multi-stakeholders

dialogue (Water dialogue) to higher level of institutions (Province, National, Regional); (ii) to coordinate a planning process that will have to be inserted into several decentralized socio-economic development plans and (iii) sometimes, to find the way within different political, legal and institutional frameworks (mainly the case when considering the LMB). Another approach is to identify the factors to be considered for “smooth relationships” between upstream-downstream such as minimum flow, water quality, natural flow cycle, river ecology, groundwater, etc., and establish mutually accepted rules for maintaining these factors within reasonable ranges.

This training will refer to the Courses N°2 (“River Basin Development Planning”) and N°3 (Trans-boundary River Basin Management) in the Training Plan.

This training module is part of the Training Plan:

**Figure 4: Training Plan Organization Chart**





## B. Expected Outputs

The expected outputs are:

- Understanding the 5 steps of the IRBM cycle
- Understanding the concept of “Stakeholders mapping” and the role of the different groups of Stakeholders when developing shared vision, river basin road map, river basin management plan and monitoring tools
- Understanding different possible approaches and coordination tools for developing water dialogue framework and conducting RBM process (e.g. RBO, River Basin Authority, etc.)
- Understanding the additional challenges and coordination tools when the RB is shared (i) between different administrative entities (Provinces, Districts) and (ii) between different countries.
- Identification of key factors of success for RBM implementation in the specific case of Lao PDR

## C. Main topics covered

The topics that will be covered by this training are listed below. They will be developed with a wide perspective, not going into much into details. Other trainings will be organized in order to go deeper into the details of some of the areas covered by this training.

- **The 5 steps of the RBM cycle:** (i) Basin Profile; (ii) Water Dialogue for identification of issues, opportunities (where we are now...) and develop shared vision (where do we want to go...); (iii) Basin road map (What to do to go where we want...); (iv) Basin Management Plan: generally based on the 5 years socio-economic plan – how to mainstream this plan into the existing legal and administrative framework; (v) Monitoring tools
- **Stakeholders identification - Water Dialogue Framework – Water Leadership:** Methods for identify and mapping the stakeholders of the RB and definition of the Water Dialogue Framework and Water Leadership
- **Models of Coordination Tools for developing the Water Dialogue Framework:** Through case-studies – International, regional and national, show different models of Coordination Tools (RBO, River Basin Authority, Watersheds initiative, etc.)

- **Additional challenges when facing trans-boundary basins:** Important factors to consider for “smooth relationships” between upstream-downstream such as minimum flow, water quality, natural flow cycle, river ecology, groundwater, etc.
- **Analysis of key constraints and factors of success:** Actually, the implementation of RBM may be jeopardized, or at least hindered by numerous constraints that are generally very specific to the country context and also the basin issues and actors. During the training, the participants will try to identify these key constraints and factors of success, from the various experiences in Lao PDR and in LMB.

## D. Methodology to be developed

As many participants have already a sound knowledge of RBM principles and practical experience in implementation, the training will be more oriented on:

- Getting a wider perspective of the different possible options for developing RBM and the related coordination tools (through a presentation of international and regional case-studies);
- Developing analysis of the constraints and key factor of success in the specific case of Lao PDR.

The Training will be organized using the following modalities:

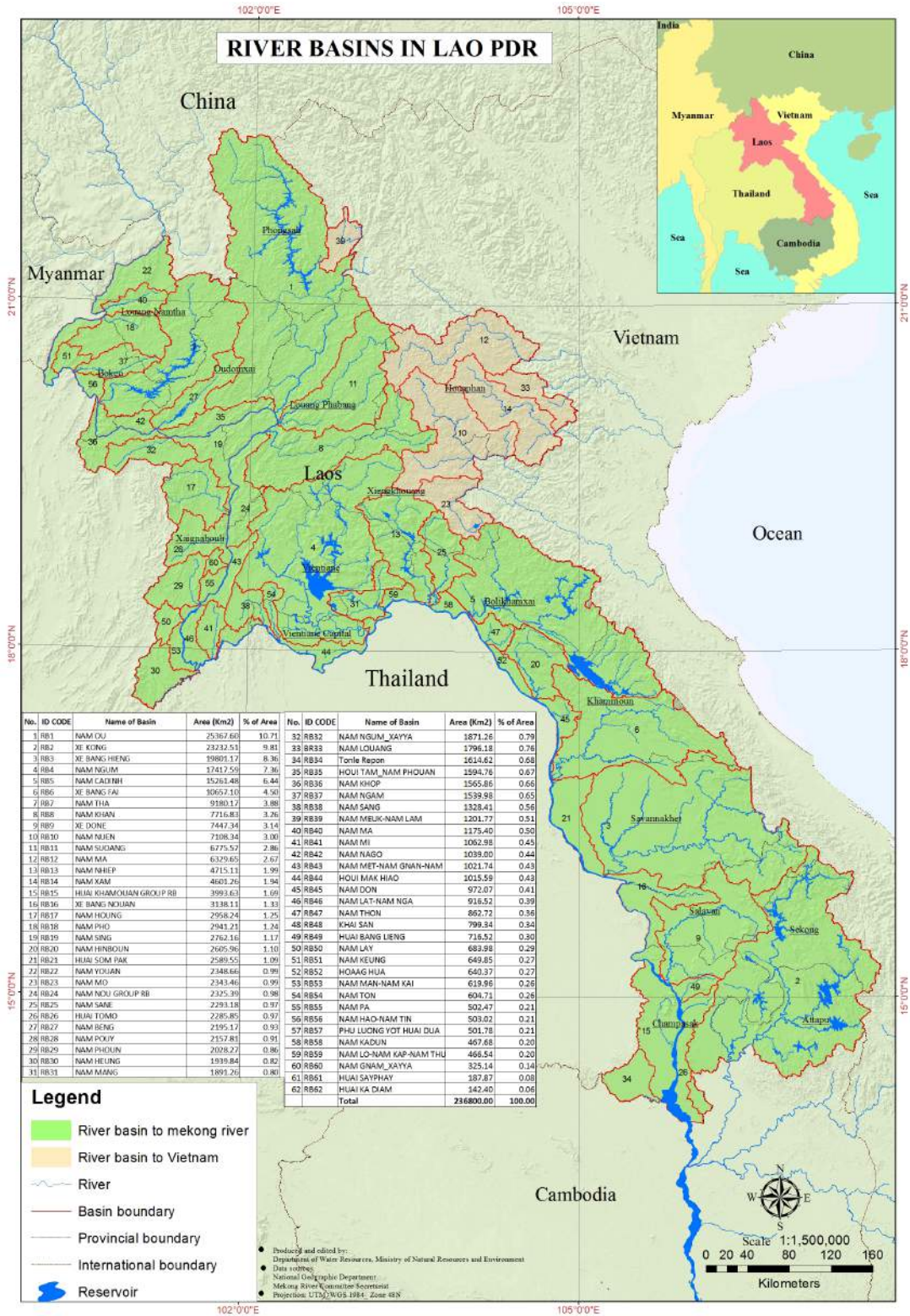
- **Formal Presentation (Lecturer):** Definition and concepts for:
  - Steps of the RBM cycle;
  - Stakeholders Analysis and Water Dialogue;
  - Coordination tools (RBO, Watershed Committees, etc.);
  - Trans-boundary challenges.
- **Case-studies and Discussions Group:** Presentation and Group Discussions on case studies related to:
  - River Basin Management Plans
  - Coordination Tools (RBO, Watershed Committees, etc.)
- **Discussions Groups:** Identification of:
  - Key factor of success when developing RBM

## E. Modules

Modules	Brief Content	Program
<b>Module 1: The IRBM Steps and Cycles</b>	<ul style="list-style-type: none"> <li>• Basin profile</li> <li>• Issues, opportunities and vision</li> <li>• Road map</li> <li>• River basin Management plan</li> <li>• Monitoring</li> </ul>	Formal presentation of the concepts
<b>Module 2: Case-Studies River Basin Management Plan</b>	Sort out 4 case-studies (2 International, 1 regional and 1 Lao) <ul style="list-style-type: none"> <li>• Compare the global context</li> <li>• Compare key elements of methodologies</li> </ul>	Discussion groups (4 groups)
<b>Module 3: Stakeholders Analysis and Water Dialogue</b>	<ul style="list-style-type: none"> <li>• Stakeholders analysis</li> <li>• Water dialogue</li> <li>• Water leadership</li> </ul>	Formal presentation of the concepts
<b>Module 4: RBOs - Coordination Tools</b>	<ul style="list-style-type: none"> <li>• General role and functions</li> <li>• Possible options</li> </ul>	Discussion groups (4 groups)
<b>Module 5: Case-Studies RBOs - Coordination Tools</b>	Sort out 4 case-studies (2 International, 1 regional and 1 Lao) <ul style="list-style-type: none"> <li>• Compare the global context</li> <li>• Compare key elements of methodologies</li> </ul>	Discussion groups (4 groups)
<b>Module 6: Transboundary Challenges</b>	<ul style="list-style-type: none"> <li>• National “Transboundary” Basins</li> <li>• LMB context</li> </ul>	Formal presentation of the concepts
<b>Module 7: Key Factors of Success</b>	<ul style="list-style-type: none"> <li>• Identify the key factors of success in Lao PDR</li> </ul>	Discussion groups



**Figure 5: River Basin Map of Lao PDR**



# III. Training Program Agenda

## Day 1

Time	Program	Resource Person
8:30-8:40	Welcome speech	PONRE Khammouane
8:40-8:50	Opening speech	Training Director
8:50-9:15	Introduction of the training Introduction of participants and sharing expectations	CTA
<p><b>Session 1: River Basin Management Steps and Cycle</b></p> <p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>To introduce and dialogue on key international concepts, each steps and definitions of IRBM, as well as to exchange experiences and key challenges at national and project levels, considering in the last ten years of IRBM implementation in Laos.</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>Technical and lesson learnt presentations and active dialogues</li> </ul>		
9:15-10:00	Introduction of River Basin Management <ul style="list-style-type: none"> <li>IRBM Steps and Cycle</li> <li>Terms and definitions</li> <li>Discussions</li> </ul> <p><i>Keynote presentation 1 (English)</i></p>	International IWRM Specialist
10:00-10:30	Institutional Setting of RBM in Laos. <ul style="list-style-type: none"> <li>Current management plan (Nam Thuan Nam Krading)</li> <li>Experiences and challenges</li> <li>Discussion</li> </ul>	Training Director
10:30 -10:45	Break	
<p><b>Session 2: Stakeholder Analysis, Participation and Assessment Tools</b></p> <p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>To introduce theoretical concepts, systematic thinking frameworks, tools and cases, as well as to exchange experiences of “stakeholder analysis” “RB participation” and “assessment” in both policy and project levels and in different stages of implementation.</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>Presentations and active discussions</li> <li>Group discussions</li> <li>Short films and discussions</li> </ul>		
10:45 –12:00	Stakeholder Analysis and Participation Tools <ul style="list-style-type: none"> <li>Analysis of projects or planning</li> <li>Stage of planning and management</li> <li>Case of Nam Thuan project</li> <li>Tools and approaches</li> <li>Discussions</li> </ul> <p><i>Keynote presentation 2 (English)</i></p>	International IWRM Specialist
12:00-13:00	Lunch	

## Day 1

Time	Program	Resource Person
13:00-13:45	Short documentary: community participatory river management • Discussion  <i>Short film: Thai Baan Research, a case study of local wisdom and self-community river basin awareness building</i>	Facilitator
13:45-14:30	Case studies - community fisheries in Laos • Discussion  <i>Keynote presentation 3 (Lao)</i>	National Training Specialist
14:30-14:45	Break	
14:45-15:00	Team building – Game	Facilitator
15:00-16:30	CIA/EIA/SIA and implementing cases in Lao PDR New E/SIA Law in Laos • Discussion	ESIA Department, MONRE

## Day 2

Time	Program	Resource Person
<b>Session 3: River Basin Planning and River Basin Organization</b> <b>Objectives:</b> <ul style="list-style-type: none"> <li>To introduce and dialogue on concepts, approaches and tools of RB planning and RBO, and actual implementation experiences and key challenges</li> </ul> <b>Methodology:</b> <ul style="list-style-type: none"> <li>Presentation and active discussions</li> <li>Plenary discussion</li> <li>Group exercise to assess strengths and weaknesses of RBOs and national RBM implementations, as well as to provide concrete recommendations in participatory fashion</li> </ul>		
8:30-8:45	Recap from Day 1	Group Representatives
8:45-10:30	River Basin Organization • Concepts, expected roles and responsibilities of RBO  Case studies and experience • Nam Ngum Basin Organization • Nam Thuan-Kra Ding River Basin Committee  Group and plenary discussions  <i>Keynote presentation 4 (English)</i>	International IWRM Specialist
10:30-10:45	Break	
10:45: 12:00	Key development and management challenges of RBM in Laos  Presentation on lessons learnt and experience • Land use and rubber plantation • Climate change	Researchers in Laos
12:00-13:00	Lunch	

Time	Program	Resource Person
13:00-13:30	Short documentary: key challenges in RBM • Discussion	Facilitators
13:00- 14:30	Technical planning tools and experiences • Scenarios/modeling tools • GIS  <i>Keynote presentation 5 and 6 (Lao)</i>	DWR Modelling Unit
14:30-14:45	Break	
14:45-15:00	Team building - game	Facilitator
15:00-16:30	Planning tools and experiences Group exercises	Facilitator
18:00	Dinner	

## Day 3

Time	Program	Resource Person
<b>Session 4: Site Visits: Hydropower Development Project</b> <b>Objective:</b> <ul style="list-style-type: none"> <li>To compliment this IRBM training course by actual case and field studies of one of the most critical project implementations that has large impacts upon the river basins in Laos. The trainees will have opportunities to learn about the complexity of how large-scale project plays the critical roles in changing the face of the river courses and basins in conjunctions with national and social development, and river basin conservation.</li> </ul> <b>Methodology:</b> <ul style="list-style-type: none"> <li>Field visits and key stakeholder interviews</li> </ul>		
8:30-10:00	Travel to NTPC	PONRE Khammouane
10:00-12:00	NTPC presentation <ul style="list-style-type: none"> <li>Project development</li> <li>Stakeholder participations</li> <li>Impact mitigation</li> <li>Benefit sharing</li> </ul>	NTPC2
12:00-13:30	Lunch	Admin team
13:30-15:00	Site visit to NTPC <ul style="list-style-type: none"> <li>Hydropower</li> <li>Resettlement areas</li> </ul>	PONRE / NTPC2
15:30-16:30	Travel back to Khammouane Province	Admin team

## Day 4

Time	Program	Resource Person
<b>Session 5: Trans-boundary Management and Challenges</b> <b>Objective:</b> <ul style="list-style-type: none"> <li>To supplement the Day 5 learning with the complication of trans-boundary issue.</li> </ul> <b>Methodology:</b> <ul style="list-style-type: none"> <li>Field visits and key stakeholder interviews.</li> </ul>		
8:00-8:30	Recap from day 3	Group representatives
8:30-09:30	Travel to Xai Bang Fai	Admin team
09:30-10:00	Briefing on Xai Bang Fai management and key issues	DONRE
10:00-12:00	Site visit, meet villagers	Group representatives
12:00-13:30	Lunch	Admin team
13:00 – 14:00	Travel back to the meeting place	Admin team
14:00-14:30	Break	Admin team
<b>Session 6: Group Exercise</b> <b>Objective:</b> <ul style="list-style-type: none"> <li>Based on the training of the last four days, it expects the trainees to be able to adopt the approaches and tools, as well as to identify critical opportunities and gaps of Nam Thuan and Xai Bang Fai Basins for a brief proposal development of IRBM planning. The proposal plan will be presented to the Khammouane authorities and stakeholders.</li> </ul> <b>Methodology:</b> <ul style="list-style-type: none"> <li>Small group exercises.</li> <li>Proposal presentations.</li> <li>Plenary discussion.</li> </ul>		
14:30-16:30	Small group exercise  Each group conducts IRBM planning of Nam Thuan and Xai Bang Fai Basins by picking up key challenges that they have learnt from the previous days of training (More detail of the exercise to be given later).	IWRM Training Specialist



## Day 5

Time	Program	Resource Person
8:30-8:45	Recap from day 4	Group representatives
8:45-10:00	Continued group exercise	IWRM Training Specialist
10:00-10:20	Break	Admin team
10:20-11:30	Presenting each Plan to Khammouane Provincial Governor and PONRE Plenary discussion	Group representatives
11:30-12:00	Training evaluation	Mr. Chanthaphone
12:00-13:30	Lunch	Admin team
13:30 -18:00	Travel back	Admin team




# IV. Training Materials

## Keynote presentation 1: Introduction of River Basin Management (English)

**INTRODUCTION OF RIVER BASIN MANAGEMENT**

NIWRMSP Building Capacity:  
Package 1  
Training : River Basin Management

 Eric Tilman  
International Consultant  
[www.riversnetwork.org](http://www.riversnetwork.org)

### SOME DEFINITION



River Basin



Watershed



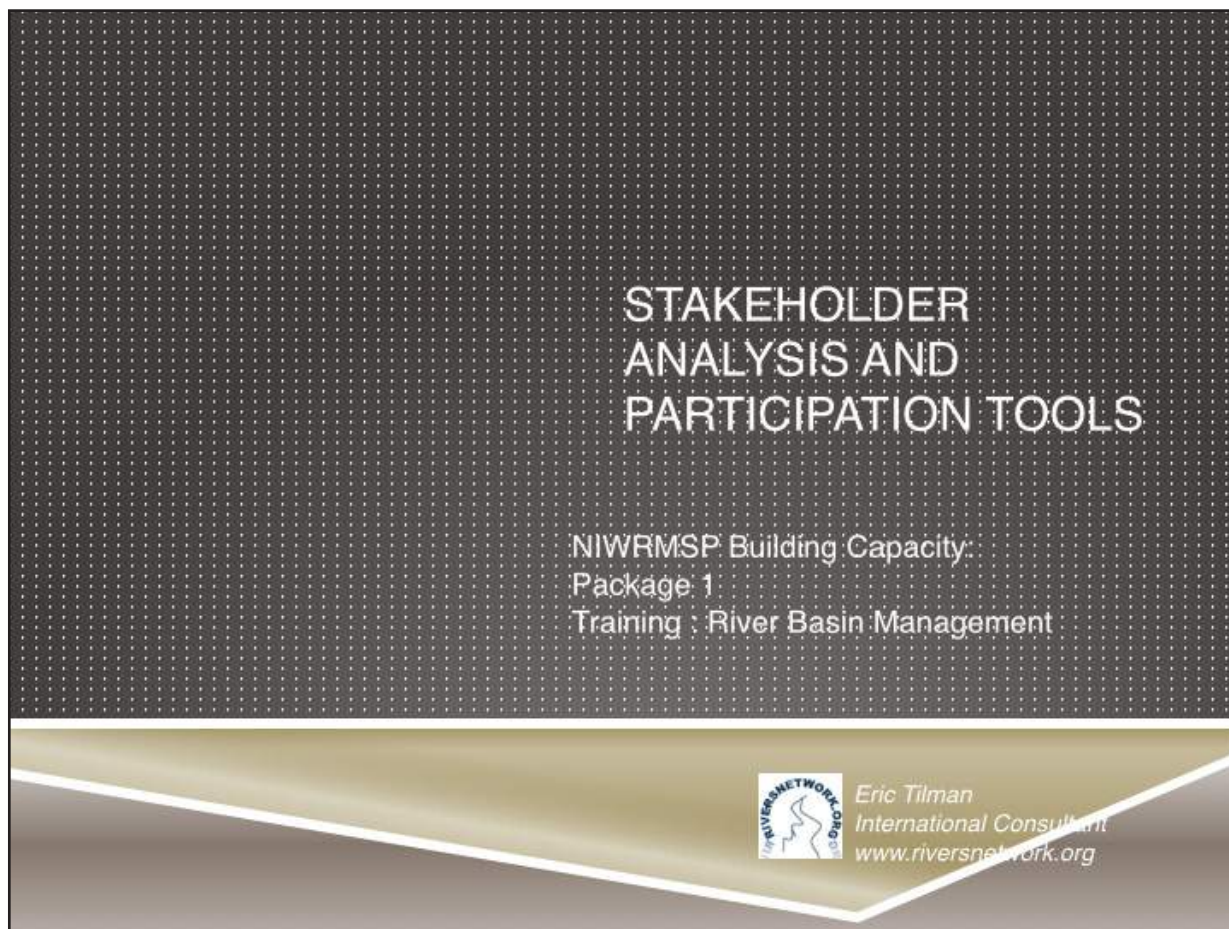
Wetlands

### IDENTIFY AND RECOGNIZE SPECIFICITIES ... EVERY BASIN IS DIFFERENT

Whether the basin is within one country or several countries;	The scale of planning and management (transboundary, national, local);
The stage of development in the basin, for example as regards the economy, infrastructure;	The stage of development of the basin management organisation;
The main water management challenges, for example population pressure, sanitation, food production, health, flood and drought protection; and	The social, economic, political and institutional environment.



## Keynote presentation 2: Stakeholder Analysis and Participation Tools (English)



**Figure 6: Who are Stakeholders**



# ການຄຸ້ມຄອງການປະມົງ ແບບມີສ່ວນຮ່ວມ ໃນ ສ ປປ ລາວ



ໂດຍ: ຈັນທະພອນ ທຳມະວົງ  
IWRM Training Specialist

## ບົດສະເໜີ

- ປະສົບການຂອງ ກົມລ້ຽງສັດ ແລະ ການປະມົງ ແລະ ກອງທຶນອະນຸລັກທຳມະຊາດໂລກ ໃນ ການຄຸ້ມຄອງການປະມົງ
- ວິທີການ ແລະ ບັນດາກິດຈະກຳ ໃນການສ້າງ ແຜນການຄຸ້ມຄອງຊັບພະຍາກອນປະມົງ
- ກໍລະນີສຶກສາ ກ່ຽວກັບຊັບພະຍາກອນປະມົງ
  - ການຄ້າປະກັນດ້ານສະບຽງອາຫານ

## ປະສົບການຂອງ ກົມລ້ຽງສັດ ແລະ ການ ປະມົງ ແລະ ກອງທຶນອະນຸລັກທຳມະຊາດ ໂລກ ໃນການຄຸ້ມຄອງການປະມົງ

ໄດ້ລີ້ເລີ້ມ ປີ 2005

- ສຸມໃສ່ການຄຸ້ມຄອງຊັບພະຍາກອນປະມົງ
- ພັດທະນາຊີວິດການເປັນຢູ່ ໂດຍການຊຸກຍູ້ ການ  
ຄຸ້ມຄອງຊັບພະຍາກອນປະມົງແບບຍືນຍົງ
- ຊຸກຍູ້ການສ້າງນະໂຍບາຍໃນການຄຸ້ມຄອງ  
ຊັບພະຍາກອນປະມົງແບບມີສ່ວນຮ່ວມ

## Keynote presentation 4: River Basin Organizations (English)

# RIVER BASIN ORGANISATION

NIWRMSP Building Capacity:  
Package 1  
Training : River Basin Management



Eric Tilman  
International Consultant  
[www.rivernet.org](http://www.rivernet.org)

### WHAT IS RBO "RIVER BASIN ORGANISATION"

**Management of Water Resources at Basin Scale**  
- The term "basin organisation" refers to any formal or informal entity that manages water resources at the basin scale.

**Many possible institutional arrangements**  
- Basin organisations are set up under different arrangements depending on the aim, the legal and administrative systems, and human and financial resources.

**Formal or less formal bodies**  
- They are usually, but not always, formal legal bodies. In some cases less formal arrangements also work. But, whatever the set up, basin organisations must be public sector organisations because water resources management is a public good.

**Include a wide range of stakeholders**  
- Although formal basin organisations are part of the public sector, for water to be managed effectively, a wide range of stakeholders, community groups, occupational sectors, nongovernmental organisations and private enterprise, need to be involved.

### WHY AN RBO ? FACTS...

- Many river basins and watersheds in the world are running without a formal RBO
- River basins and watersheds may have several "RBOs" : official, grassroots initiative, public-private partnership, ...
- RBO is not an IWRM : goal
- RBO is one of the tool for water management



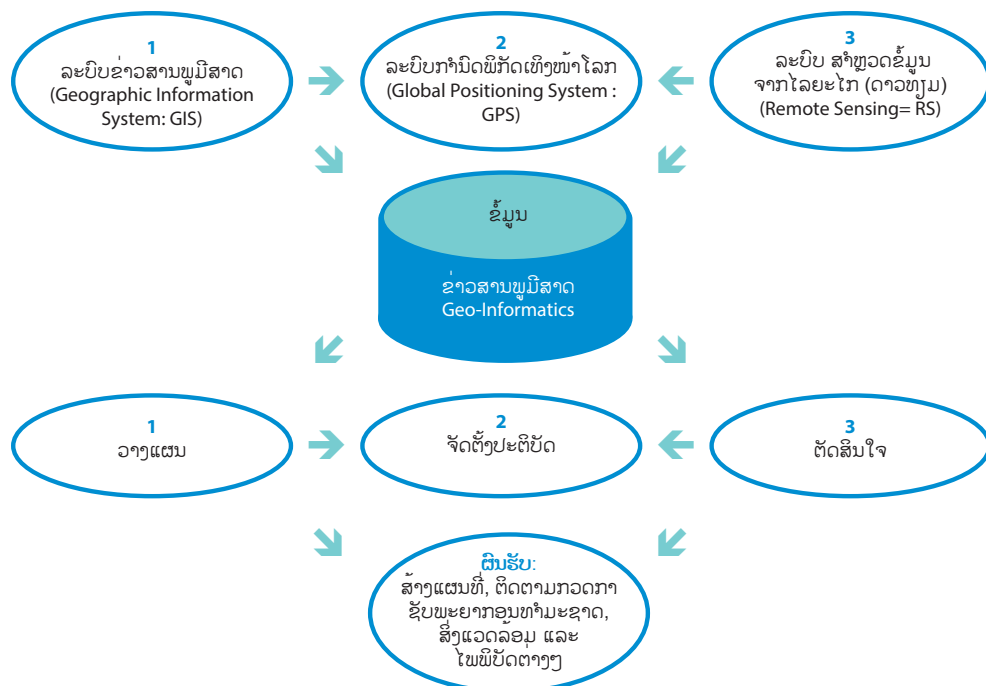
Group Exercise

RBO : Advantages	RBO : Disadvantages





Figure 7: ລະບົບພູມິສາດ (Geomatics System)





**ຄວາມຮູ້ພື້ນຖານ ກ່ຽວກັບ  
ຕົວແບບຈໍາລອງອຸທິກກະສາດ**

ໂດຍ ລັດຕິກອນ ໄຊຍະສານ  
ສູນຂໍ້ມູນຂ່າວສານ ຊັບພະຍາກອນນໍ້າ  
ກົມຊັບພະຍາກອນນໍ້າ  
ກະຊວງ ຊັບພະຍາກອນ ທໍາມະຊາດ ແລະ ສິ່ງແວດລ້ອມ

**ສາລະບານ**

- ນິຍາມ ຂອງ ຕົວແບບຈໍາລອງ
- ປະເພດ ຂອງ ຕົວແບບຈໍາລອງ
- ການນໍາໃຊ້ ແລະ ຄວາມສໍາຄັນ ຂອງຕົວແບບຈໍາລອງ
- ຕົວແບບຈໍາລອງ ທາງອຸທິກກະສາດ

**ຕົວແບບຈໍາລອງແມ່ນຫຍັງ?**

ວິທີການ ທາງວິທະຍາສາດ ໃນການສ້າງຄວາມເຂົ້າໃຈ, ກໍານົດ, ຊອກຫາປະລິມານ, ສະແດງພາບ ຫຼື ຄໍານວນ ປະກົດການ ຂອງໂລກ ແບບງ່າຍ. ມັນຮຽກຮ້ອງ ບັນດາຂໍ້ມູນ ທີ່ກ່ຽວຂ້ອງ ຂອງ ສະຖານະພາບ ໃນໂລກ ໂດຍນໍາໃຊ້ ຕົວ ແບບຈໍາລອງ ທີ່ແຕກຕ່າງກັນ ຕາມແຕ່ລະຈຸດປະສົງ, ເຊັ່ນ ຕົວແບບຈໍາລອງ ທາງຄວາມຄິດ ເພື່ອເຮັດໃຫ້ເກີດຄວາມ ເຂົ້າໃຈ ທີ່ດີຂຶ້ນ; ຕົວແບບຈໍາລອງ ທາງດ້ານຄະນິດສາດ ເພື່ອ ຄໍານວນປະລິມານ, ຫຼື ຕົວແບບຈໍາລອງ ດ້ານຮູບພາບ ເພື່ອ ການສະແດງຜົນ ຂອງວັດຖຸ. ຕົວແບບຈໍາລອງ ມີຄວາມສໍາຄັນ ແລະ ບໍ່ສາດແຍກອອກຈາກກິດຈະກໍາ ທາງວິທະຍາສາດໄດ້, ແລະ ຕົວແບບຈໍາລອງ ກໍ່ມີຮູບແບບແນວຄິດ ທີ່ແຕກຕ່າງ ກັນ.

## Short films: Thai Baan Research, a case study of local wisdom and self-community river basin awareness building

Figure 8: Thai-Baan: The Life Pulse of the Songkhram (1/2)

<https://www.youtube.com/watch?v=k-FXQt9A41U>



Figure 9: Thai-Baan: The Life Pulse of the Songkhram (2/2)

<https://www.youtube.com/watch?v=icL7sYi3ddQ>





# **Training Manual for River Basin Knowledge Development**



# I. Fact Sheet

Name of training course:	<b>River Basin Knowledge Development From River Basin Profile to River Basin Information System</b>
Level and specialty:	Medium level and on-the-job based training
After the training, the trainees will:	<ol style="list-style-type: none"><li>1. Gain improved knowledge and capacity to understand concepts and practical methodologies in developing river basin knowledge.</li><li>2. Gain improved capacity to classify and prioritize types of river basin knowledge - and identify pilot sites with suitable/participatory methodologies for on-the-job training to develop river basin profiles in Lao PDR.</li><li>3. Gain practical field experience in conducting field level studies in data collection and analysis</li><li>4. Build up a multi-disciplinary team in developing a work-plan and proposal for river basin knowledge development in their own region with realistic goals, objectives, and step by step outputs.</li></ol>
Target groups:	River basin managers from central, provincial, district and river basin levels. River Basin Organizations, University of Laos
Number of training days:	3 days
Dates and venue of training:	This training was already conducted two times for different target groups. <ol style="list-style-type: none"><li>1. For Central and Northern regions that include Nam Tha, Nam Ou and Nam Ngum Basin, held in Vientiane Capital on 29 September – 1 October 2014</li><li>2. For southern region that include Nam Thuan-Nam kradang, Xaibangfai, Xaybhanghien and Sekong Basin, held in Thakhek District, Khammouane Province, on 13-15 October 2014</li></ol>
Number of trainees:	<ol style="list-style-type: none"><li>1. 77 trainees (17 women and 60 men)</li><li>2. 49 trainees (19 women and 30 men )</li></ol>
List of trainees:	See Annex A-3
List of principal trainers:	Mr. Bounsangong Fongnaly, Training and Awareness Building Unit Director, Department of Water Resources Ms. Kate Lazarus, Senior Operation Officer, IFC Ms. Nancy Kim, Country Coordinator, The Asia Foundation Mr. Eric Tilman, International IWRM Specialist Mr. Suparerk Janprasart, Chief Technical Advisor and Team Leader

#### Training methodologies:

The training was divided into four different sessions which exploited different methodologies that include:

- Keynote presentations and interactive discussions prepared by the trainees themselves
- Keynote presentations and interactive discussions prepared and facilitated by trainers
- Multi-disciplinary team set-up and building
- Primary and secondary database analysis
- Field trip and field exercises in sampling, hydrological survey, biodiversity survey, bio-monitoring survey, rapid social and livelihood survey, local stakeholder interviews and use of scientific equipment
- Small group exercise and plenary presentations
- Work plan development

#### Training materials:

1. Situation Analysis, Training Concept and Training Modules
2. Training Program Agenda with Training Methodologies
3. Keynote Presentations
4. Official Guidelines Documents

#### Recommended additional reference materials:

1. Xaybongfai-Xaybonghien River Basin Profile, Department of Water Resources
2. Nam Ngum River Basin Profile, Nam Ngum River Basin Committee Secretariat

#### Training assessment results and findings:

**River Basin Knowledge Development Training** was held twice - once in Vientiane Capital and again in Khammouane Province, targeting different groups of trainees.

The first round of training, "**River Basin Knowledge Development Training for Central and Northern Regions**", was held on 29 September - 1 October 2014, in Vientiane Capital. The training targeted the trainees from northern and central part of Lao PDR. 77 participants attended the first training. Those trainees were representing three key river basins of northern and central parts of Lao PDR, which are Nam Ou, Nam Tha and Nam Ngum River Basin. This training was a co-funded activity between International Finance Corporation and ADB TA 7780, and in partnership with WB-MIWRM Project and The Asia Foundation. The training was collaboratively prepared with all the technical teams from DWR, IFC, WB-MIWRM Project and The Asia Foundation (TAF) through a number of technical discussion meetings, in order to identify and refine the most suitable approach and methodology, as well as to prepare an acceptable co-funding plan.

The training introduced basic knowledge and key principles of the river basin knowledge development, concentrating on how to make "river basin profile". The training also separately facilitated a field trip and on-the-job training group exercises by grouping the trainees into their respective basins i.e. Nam Tha, Nam Ou and Nam Ngum Basins.

Training assessment results and findings:

This training received a fair amount of positive feedbacks and it was assessed to have partly met its objectives. Many recommendations given by the trainees were mostly about the potential improvement of the adopted methodology specific to each of the basins. For example, the number of sampling for field survey sites proposed for basin profile development was too few, and therefore limits the ability to upscale to cover a bigger region i.e. the entire river basin. Every trainee also agreed that the river basin knowledge or the development of the river basin profile must be able to give a good overview picture of the whole basin, as well as to address the key issues and hot spots. Case studies would also benefit the training and would be necessary to provide in-depth information. It was also suggested that the content of the teaching materials and the information on river basin profile must be updated and disseminated regularly due to the rapidly changing face of land use as the result of industrial development, hydropower development, urbanization, deforestation as well as climate change.

All trainees were excited to continue gathering knowledge and information about their own basins. The representatives from Nam Ngum River Basin proposed to improve their own 2013 State of the Basin Report if they have the technical guidance and financial support. The representatives from Nam Tha River Basin requested funding from DWR to start a river basin profile development initiative for Nam Tha Basin. The representatives from Nam Ou Basin expressed their desire to work closely with IFC to develop the Nam Ou basin profile under IFC/Australian Aid support. The average assessment score received by all the trainees was **6 out of 10**.



The second training, “**River Basin Knowledge Development Training for Southern Region**”, was organized in Thakhek district in Khammouane Province on 13-15 October 2015. There were 49 trainees representing Nam Thuan-Nam Krading, Xaybangfai, Xaybanghien and Sekong Basins. The objectives of this training were similar to the previously implemented training for the central and northern regions. However, the methodology and approach were revised and improved based on the recommendations and lessons learnt received from the first training. The WB-MIWRM Project and TAF were participating as the partners of this training. TAF contributed a big team of resource persons and assisted in facilitating the field survey exercises.

The training provided the opportunities to Xaybangfai-Xaybanghien and Sekong Basin teams to present their on-going work in River Basin Profile development. The training also encouraged the participants to discuss the strengths and weaknesses of the ongoing works. The key issues identified include the lack of accurate data and the lack of community engagement. For instance, the first and secondary data used in the development of river basin profile were not well-presented and verified and thus widen the knowledge gap rather than closing the gap. It was also pointed out during the training that the basin profile was prepared without the participation of the local communities in the basins, and therefore could be improved.

The trainers introduced a methodology that prioritizes and addresses the critical issues of the basins. The trainers also emphasized the target-user approach to be incorporated during the planning stage for river basin profile development. The introduction and discussion of new community engagement method received positive feedbacks from the participants. Most found the newly introduced method to be very useful and relevant to the making of good river basin profile. The trainees appeared to be very satisfied with the training. The average score of the training is **8 out of 10**. The Xaybangfai-Xaybanghien team (which is currently supported by the WB-IWRM Project) submitted the request to the ADB team and TAF team to provide further assistance for the continuous development of their river basin profiles.

#### Next steps and Recommendations:

1. Identify clearer target stakeholders who will use and benefit the river basin knowledge.
2. Further engagement with technical experts in knowledge building especially with the Xaybangfai-Xaybanghien Basin team.
3. Organize the similar training once a year with the same trainee group as to update their local water situation and monitor progress of their water management skills, and to strengthen team building.



## II. Situation Analysis, Training Concepts and Training Modules

### A. Justification

All decisions generally rely on knowledge, experience and lessons learned. Knowledge is actually an essential pillar for decision making for the River Basin Managers and Stakeholders. A good starting point for knowledge acquisition is what we call a "River Basin Profile". It consists to gather information and data on various topics like physical and geographical location of the river basin, hydrology and meteorology, socio-economy, natural resources and potential development. A river basin profile generally includes a chapter that tends to identify the pressure on natural resources that may result from the expected development.

Several River Basin Profile exercises have been carried out in Lao. It may have been developed within the framework of the MRC (LMB Basin Development Program), as part of national sub-basins to be aggregated into a broader Mekong Basin perspective. It may also have been developed within the framework of target basins like the case recently in Nam Ngum, Nam Ton and Nam Ou.

In Lao PDR, the River Basin Profiles are generally carried out in a "one shot" perspective, very often driven by a project implementation. This means that the expected output is a River Basin Profile Report which, when delivered is considered as the end to the process. This report is used as a "baseline survey" reference but become rapidly obsolete until a new exercise may be organized when interests and funds are available. Drafting a River Basin Profile is quite a substantial and expensive work that requests a good skilled team and a positive collaboration of the different sector's agencies in order to get access to the information and be allowed to share it in the Basin Profile report.

A good point is that the activities organized by the Teams who conduct the River Basin Profile generally allow creating a momentum for inter-agencies cooperation on the issue of natural resources management and the pressure that socio-economic development may generate on these resources. This is actually at the heart of IWRM perspectives. But the fact that the process is as said a "one shot" perspective makes that this momentum is rapidly lost.

In addition, summarizing the knowledge in a traditional basin profile report does not allow taking profit of the new knowledge acquisition means and

information technologies that are now at our disposal. For example, videos are a wonderful tool for keeping memory of local knowledge. For example as well, Models, GIS and other information tools allow frequent updated analyses and following up of river basin issues and risks. This is much more efficiently than going back to the baseline survey and manually reporting the data into a spread sheet, even if, for simple case, this method may remain the good option.

The River Basin Profile exercise should take into consideration extended final outputs. Ideally, we should think now, as ultimate goal, about setting up networking and dissemination mechanisms allowing having permanent (or quasi-permanent) access to the information available at different sector agencies and other potential partners. By the end, it could provide regular (or even automatic) update of the basin profiles and therefore make easier the following up of the major trends in terms of development and impact on the resources. This would be a dynamic process instead of a static one.

It is important to note that this concept has been developed in many countries, using widely the possibilities of networking the relevant stakeholders around an information sharing platform. Nearly all Ministries in charge of Water Resources Management are now developing or planning to develop platforms or portals for such purpose. This may be a huge shift as well in terms of IWRM approaches and Water Governance considering networking as part of a significant step forward into the process of inter-agencies collaboration.

For that reason, we suggest for this training module to revisit the concept of "**River Basin Profile**" replacing it by a more updated terminology which would be "River Basin Information System", as a result of a process of knowledge development. This implies focusing on the following topics:

- **Objectives of "River Basin Knowledge" Development:** Final output should move from a static "River Basin Profile Report" to a dynamic "River Basin Information System" allowing shared access to updated and reliable information
- **What may the indirect outputs of the Knowledge Development?:** The "River Basin Information system" is a tool that would help to develop among others

(i) awareness material; (ii) vision development (where we are, where we are going, where we want to go); (iii) road map objectives and monitoring (evolution of selected indicators); (iv) data analysis and modelling for helping the decision process; (v) monitoring

• **What kind of Knowledge?: Knowledge must be classified:**

- Selectivity and Priorities - Do not try to be too much comprehensive: Gathering knowledge may prove to be very expensive as well as time and resources consuming. It must be decided beforehand what knowledge is actual essential, what is useful and what is not that relevant. We may refer to the concept of Table of Contents of a classic River Basin Profile. This shows sometimes that chapter may not be realistic in the limits of a reasonable cost/value added concept.
- Updating Needs: Some of the knowledge will not change in a reasonable timeline (geology, topography) and some of the knowledge is moving rapidly (socio-economic development, biodiversity, etc.).
- Format: Some knowledge are figures that may be stored in data base for further statistical analysis or models, some knowledge analysis are written description, and local knowledge should be ideally stored in a form of pictures or videos (e.g. interviews or meeting).

• **Where is the knowledge?:** The knowledge is generally accessible from very scattered sources: sector agencies, private sector, local knowledge, and this on various formats i.e. data and figures but also existing reports and all the experience that is stored in the memories of the experts and stakeholders. Selectivity and reasonable criteria must be applied here as well. Better to succeed to network a few number of reference agencies/stakeholders than failing in trying to build a comprehensive network of partners from the beginning.

• **What Methodology must be developed?:** How to develop institutional and technical mechanisms that will allow networking the information from the sector agencies on a long term basis rather than to organize complex meetings where the representative of each agency is carrying his information in his bag.

• **At what level knowledge development should be carried out?:** A logic level would be the River Basin level that could integrate their own sub-basins and some neighbor local stand-alone watersheds (like Nam Ton, a direct tributary of the Mekong). But it is not the only option. Ideally, it should be aggregated or networked at National Level. A lot of different options were developed around the world.

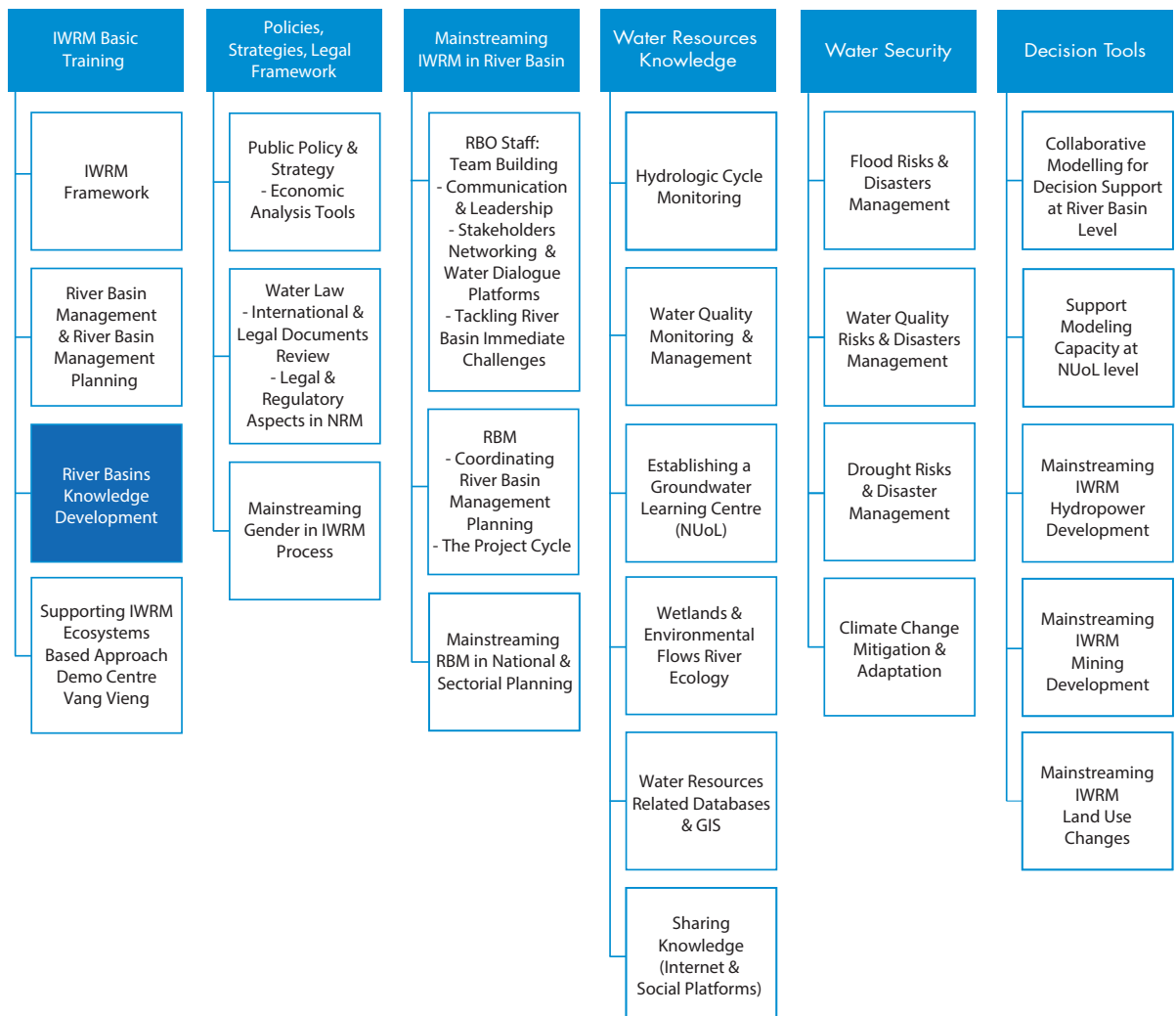
The next figure allows to localize this module within the framework of the Training Plan:







**Figure 10: Training Plan Organization Chart**



## B. Expected Outputs

The output of this training module is:

- The trainees have basic knowledge and capacities for understanding the concepts of River Basin Profile, Knowledge Development and River Basin Information System (Objectives, selective content, static and dynamic information).
- They are trained on steps and methodologies to be set up both at institutional and technical levels to create mechanisms to network agencies and relevant stakeholders to build this information.
- They are basically able to understand the different options to store and share the information (information management, concept of web portal, etc.)

## C. Main Topics Covered

The Modeling module would be composed of three sections:

### 1. Knowledge Development: Definition: Objectives and outputs

- Definition of "River Basin Profile Report"; "Knowledge"; "River Basin Information System"
- Setting up the potential objectives of river basin knowledge development
- Listing the potential outputs of River knowledge development: e.g. River Basin Information System, awareness, decision support

### 2. Classifying knowledge

- Priorities and selection of relevant information and data
- Static knowledge (not evolving in timeline) and dynamic knowledge (need regular update)
- Various possible format of knowledge: data, reports, media, etc.

### 3. Developing River Basin Knowledge: Methodologies

- Building the Team and the work plan
- Set up the institutional framework for data gathering and sharing: legal aspects, sharing process
- Technical ways of sharing and storing data and information: report, cross-link between data base, web portal

## D. Methodology

### Section 1: Knowledge Development - Definition: Objectives and outputs

- Presentation of development of River Basin Profile in Lao PDR: the case of Nam Ou river
- Formal presentations: definition, objectives and selected outputs and quick review of example of River Basin Information System from world-wide experience

### Section 2: Classifying knowledge

- Formal presentation: Classifying Knowledge
- Group Exercise:
  - Establish a Table of Content of a River Basin Profile (e.g. Nam Ou river)
  - Establish an excel file with the list of chapter and classify the data (priority, static/dynamic, where to find the information, format)

### Section 3: Developing River Basin Knowledge: Methodologies

- Formal presentations:
  - Institutional issues: How far can we share knowledge
  - Technical options for Knowledge networking and sharing
- Group exercise:
  - Apply these principles to develop a knowledge acquisition plan in Nam Ou River.

## E. Modules

Modules	Brief Content	Program	Resource Person
<b>Knowledge Development: Definition: Objectives and outputs</b>			
<b>Module 1: Case Studies</b>	Presentation of the work carried out for knowledge acquisition (Basin Profile) in the Nam Ou	Formal presentation and questions	IFC
<b>Module 2: Knowledge Development</b> Definitions, objectives and outputs	Keynote: definition, objectives and selected outputs and quick review of example of River Basin Information System from world-wide experience	Formal presentation and interactive discussion	IWRM: Training Specialist Facilitator
<b>Module 3: Rapid Exercise</b>	Ask working group to brain storm a list of key words that River Basin Knowledge evoke for them	Working group	IFC
<b>Section 2: Classifying knowledge</b>			
<b>Module 3: Presentation</b> Classifying knowledge	Classifying Knowledge – Priorities, type of information, format	Formal presentation and questions	IFC Team





Modules	Brief Content	Program	Resource Person
<b>Module 4: Exercise</b> Develop a Table of Contents of a River Basin Profile and River Basin Information System	Establish a Table of Content of a River Basin Profile (e.g. Nam Ou river)  Establish an Excel file with the list of chapter and classify the data (priority, static/dynamic, where to find the information, format)	Working groups	IFC Team

**Section 3: Developing River Basin Knowledge: Methodologies**

<b>Module 5: Presentations</b> Institutional options Technical options	Formal presentations:  Institutional options: How far can we share knowledge  Technical options for knowledge networking and sharing	Formal presentation and questions	IFC Team & IWRM Training Specialist
<b>Module 6: Exercise</b> Develop a knowledge development plan	Group exercise:  Apply these principles to develop a knowledge acquisition plan in Nam Ou river	Working groups	IFC Team & IWRM Training Specialist



# III. Training Program Agenda

## Day 1

Time	Program	Resource Person
<p><b>Session 1: What Kind of Knowledge is Needed to Understand the River Basins of Lao PDR and How Can We Collect Such Knowledge?</b></p> <p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>• To develop a general understanding of the concept behind “developing river basin knowledge”.</li> <li>• To present and discuss case studies and lessons learned from developing river basin knowledge in the Mekong region and in Lao PDR</li> <li>• To introduce methods for developing river basin knowledge</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>• Presentations</li> <li>• Plenary discussions</li> </ul>		
8:30-8:40	Welcome / opening speech	Training Director
8:40-9:00	Introduction to the training	Training Director
	Introduction of participants and sharing expectations	CTA
9:00-9:45	<ul style="list-style-type: none"> <li>• Keynote presentation: What is a River Basin Profile – General overview and case studies</li> <li>• Facilitated discussion</li> </ul>	International IWRM Training Specialist
	<i>Keynote presentation 1 (English)</i>	
9:45-12:00  30 min for each presentation including questions and answers	Introduction to existing approaches and methodologies to develop knowledge in river basins	
	1. River Basin Profile Report <ul style="list-style-type: none"> <li>• Definition</li> <li>• List of river basin contents, and priorities</li> <li>• Preparation process and data acquisition</li> <li>• Expected output</li> </ul>	DWR River Basin Profile Manager
	<i>Draft document 1 and 2 (Lao)</i>	
	2. Existing (secondary) Data <ul style="list-style-type: none"> <li>• Definition</li> <li>• Sources</li> <li>• Examples</li> </ul>	The Asia Foundation
(10:30-10:45 Coffee break)	3. Data gaps (primary Data) <ul style="list-style-type: none"> <li>• Definition</li> <li>• Methods</li> <li>• Examples</li> <li>• Participatory data collection</li> </ul>	The Asia Foundation
	<i>Keynote presentation 2 (English)</i>	
	4. Questions and answers	Facilitator: CTA
12:00-13:00	Lunch	

Time	Program	Resource Person
13:00-13:15	Game and team building exercise	DWR/CTA
<b>Session 2: In-depth Discussion of Methods for Collecting River Basin Knowledge</b> <b>Objectives:</b> <ul style="list-style-type: none"> <li>To identify specific sources of existing secondary data</li> <li>To introduce methods for primary data collection</li> </ul> <b>Methodology:</b> <ul style="list-style-type: none"> <li>Small group exercise</li> <li>Presentations by groups</li> <li>Presentations by trainers</li> </ul>		
13:15-15:00	<b>Overview of existing secondary data</b> <ul style="list-style-type: none"> <li>Summarize the types of existing (secondary) data that can be collected</li> <li>Assign teams (sector-specific) to discuss: What data exists and what are the specific sources? Also have them note which data (in their assigned category) does not exist.</li> </ul>	Facilitator: CTA
	<b>Small group exercise and presentations on “existing data sources” (one team per category)</b> <ul style="list-style-type: none"> <li>Physical characteristic</li> <li>Water resources</li> <li>Biological resources</li> <li>Agriculture and irrigation activities</li> <li>Energy and mining sector activities</li> <li>Manufacturing, industrial, and tourism sector</li> </ul>	Trainee groups
15:00-15:15	Coffee break	
15:15-16:30	<b>Introduction of field (primary) data collection (for the field trip) and introduction to site selection</b> <ul style="list-style-type: none"> <li>Team 1: Physical/Social/Livelihood team</li> <li>Team 2: Biological (Biodiversity) team</li> <li>Team 3: Bio-monitoring (Micro-invertebrate team)</li> <li>Team 4: Social/livelihood and Water Resources (led by ADB and DWR)</li> </ul> <p><i>Keynote presentation 3,4, 5, 6 and 7</i></p>	The Asia Foundation Team International Finance Cooperation Team ADB Team DWR Team



## Day 2

Time	Program	Resource Person
<p><b>Session 3: Field Exercise, Scientific and Social Survey, and Local Participatory Research Assessment Objectives:</b></p> <ul style="list-style-type: none"> <li>• To provide on-the-job training at the field level</li> <li>• To test chosen methodology and approach</li> <li>• To build understanding in interconnections between social, environmental and biophysical factors and the cumulative effects</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>• Field exercises, field surveys, local interviews etc.</li> <li>• Data collection in two villages (upstream and downstream)</li> <li>• Boat for Physical, biological and ecological team</li> </ul> <p>Location: Nam Xuang, Vientiane Province (1hr drive)</p>		
8.00-9.00	Travel from meeting venue to Nam Xuang River, the field site	All Logistics prepared by DWR
9:00-9:30	Meeting with an official representatives of Nam Xoung River	
9:30-10:00	Introduce field work and teams. Confirmation of field plans, survey materials, site locations, and logistics	
10:00-12:00	Collection of field data (Village 1 - upstream/ downstream): <ul style="list-style-type: none"> <li>• Team 1: Physical/social/livelihood team</li> <li>• Team 2: Biological (biodiversity) team</li> <li>• Team 3: Bio-monitoring (micro-Invertebrate) team</li> <li>• Team 4: Social/livelihood and water resources</li> </ul>	
12:00-13:00	Lunch	
	Collection of field data (Village 2 – 13:00-15:00 upstream/ downstream): <ul style="list-style-type: none"> <li>• Team 1: Physical/social/livelihood team (led by ADB)</li> <li>• Team 2: Biological (biodiversity) team (led by TAF)</li> <li>• Team 3: Biological (biodiversity) team (led by TAF)</li> <li>• Team 4: Water resources (led by DWR)</li> </ul>	
15:00	Return to Vientiane Capital	

## Day 3

Time	Program	Resource Person
<b>Session 4: Data Analysis and Key Findings – and Develop their Own River Basin Knowledge Development Plan</b> <b>Objectives:</b> <ul style="list-style-type: none"> <li>• Exchange and learn about how to collect data</li> <li>• Learn how to analyze data and identify key findings</li> </ul> <b>Methodology:</b> <ul style="list-style-type: none"> <li>• Small group exercise in database analysis</li> <li>• Presentations by groups to the plenary</li> <li>• Plenary discussion</li> </ul>		
8:30-9:00	Teams work together and reflect on field visits	Trainee groups
9:00 – 10:00	<b>Presentation of information collected from the field survey by participants</b> Participants will be asked to present results of their field data collection activities, and describe what they have learned from participating in the program.	Nominated presenters from each team
10:00-10:15	Coffee break	
10:15-11:00	Presentation on linking and analyzing primary and secondary data; and identifying key findings that are important for river basin management.	CTA
11:00-12:00	<b>Analyze data and develop key findings</b> Break out into river basin groups <ul style="list-style-type: none"> <li>• Review and analyze all of the secondary and primary data</li> <li>• Develop some key findings (in the following categories) that are important for river basin management. Present which data is relevant to your findings.               <ul style="list-style-type: none"> <li>• Water flow/availability</li> <li>• Water quality</li> <li>• Biodiversity</li> <li>• Social/livelihoods</li> </ul> </li> </ul>	The Asia Foundation
12:00-13:00	Lunch	



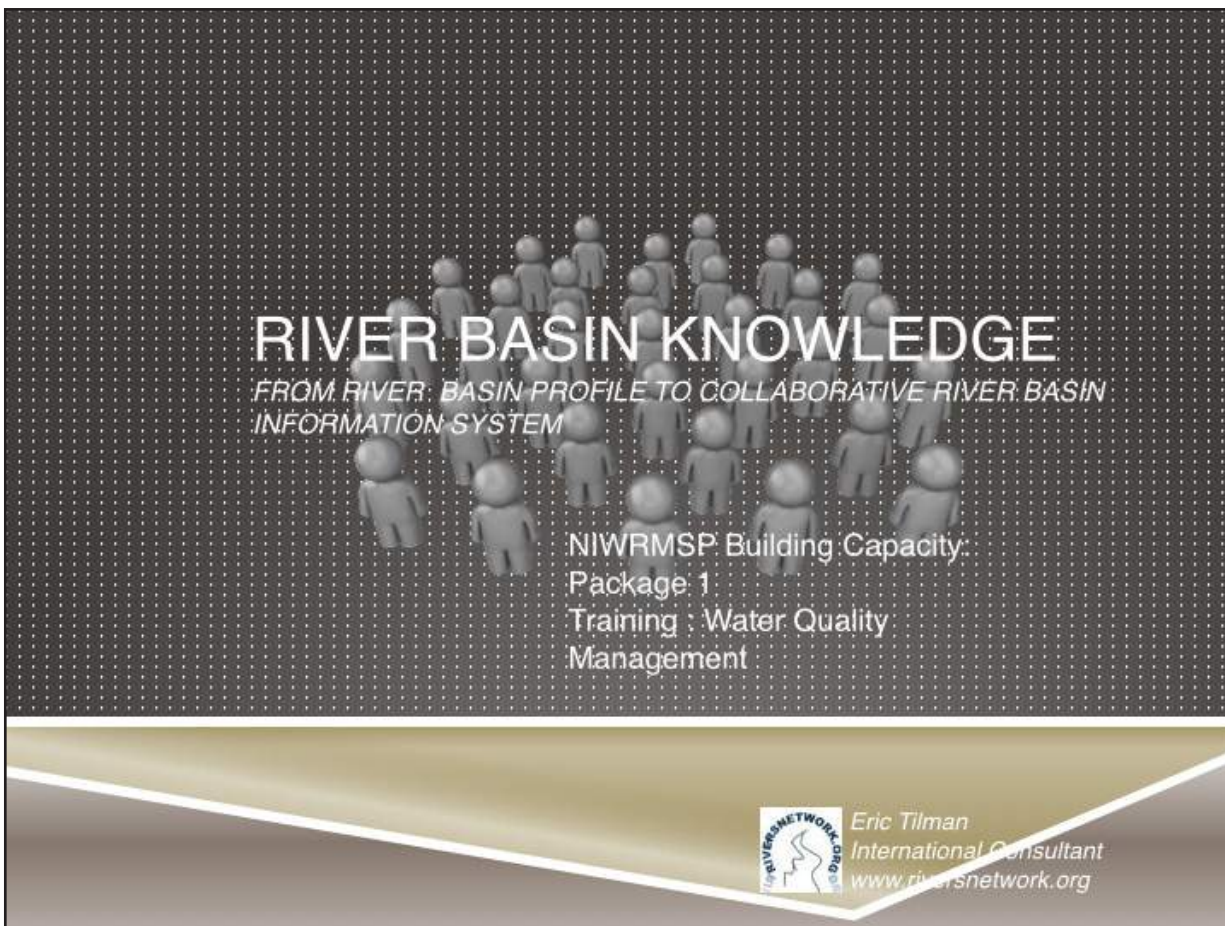


## Day 3

Time	Program	Resource Person
13:00-13:15	Game and team building exercise	DWR/CTA
13:15-14:15	<b>Present key findings</b>	Trainee groups
14:15-15:15	<p><b>River Basin Knowledge Development Plan, next steps</b></p> <p>Break out into river basin groups</p> <p>Group 1: Nam Ngum Team</p> <p>Group 2: Xaybangfai Team</p> <p>Group 3: Nam Ou Team</p> <p>Develop action plans for developing river basin knowledge, including:</p> <ul style="list-style-type: none"> <li>Existing data (who will locate and compile; timing/frequency).</li> <li>Data that needs to be collected (which of these will your river basin collect; who will collect; sites; timing/frequency).</li> <li>What kind of key issues do you all of the data that you collect (what are your priorities)?</li> <li>What kind of data did you decide not to collect? Why not?</li> <li>Who will be the overall coordinator for this process?</li> </ul>	All trainee groups
15:15-15:30	Coffee break	
15:30-16:15	Sharing of River Basin Knowledge Development Work Plan to plenary/discussion	CTA/DWR
16:15-16:30	Closing remarks	DWR


# IV. Training Materials

## Keynote presentation 1: River Basin Knowledge (English)



**RIVER BASIN KNOWLEDGE**  
*FROM RIVER BASIN PROFILE TO COLLABORATIVE RIVER BASIN INFORMATION SYSTEM*

NIWRMSP Building Capacity:  
Package 1  
Training : Water Quality Management

 Eric Tilman  
International Consultant  
[www.riversnetwork.org](http://www.riversnetwork.org)

DECISION NEEDS KNOWLEDGE



**Knowledge**

Socio-Economic Change

WHAT IS KNOWLEDGE... THE PHYSICAL CONTEXT & NATURAL RESOURCES



Geology

Hydrology & Climate

Forest Inventory

Biology & Wildlife Inventory

Fish Inventory...



## Keynote presentation 2: River Basin Knowledge Data Collection (English)



### DATA COLLECTION RIVER BASIN KNOWLEDGE



Thakek, Lao PDR  
13-15 October 2014

### Secondary (Existing) Data

#### Characteristics

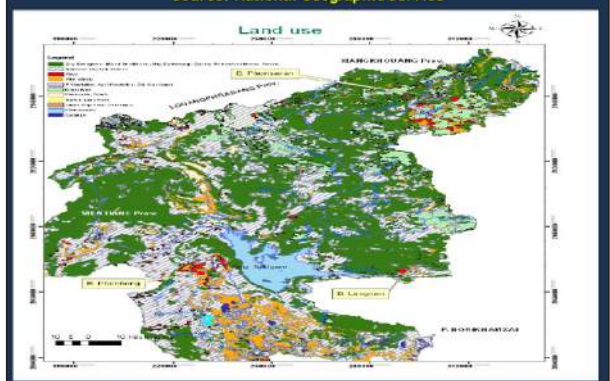
- ▶ Existing sources
- ▶ Fixed schedule/ scope
- ▶ No input/control

#### Examples

- ▶ Census
- ▶ Meteorology
- ▶ GDP

### Land Use in Nam Ngum River Basin (1999)

Source: National Geographic Service



# INTRODUCTION TO FIELD VISIT

15:30-16:30



Lilao Bouapao and Jim Webb

## OUTLINE

Objectives of the field program

Field data collection:

- Sampling design
- Questionnaire
- Interview techniques (including individual/key informants and groups)
- Mapping exercise (including traditional ecological knowledge, or TEK, mapping)
- Basic water quality
- Fisheries resources sampling
- Aquatic habitat mapping (TBD)

## FIELD PROGRAM OBJECTIVES

Provide on-the-job training for the Core Team on:

- Field sampling for physical, environmental and social data collection.
- Understanding of QA/QC

## Keynote presentation 4: Field Scientific and Social Survey and Assessment (English)

# DEVELOPMENT OF RIVER BASIN KNOWLEDGE



**IFC** | International  
Finance Corporation  
WORLD BANK GROUP

September 29-October 1, 2014

### DAY 1: ENVIRONMENTAL AND SOCIAL SURVEYS AND ASSESSMENTS





**IFC** | International  
Finance Corporation  
WORLD BANK GROUP

Kate Lazarus  
Lilao Bouapao  
Jim Webb  
September 29, 2014

#### OBJECTIVES

Objectives:

- 1) Understand the situation of the river basin and issues in the Nam Ou: e.g., water quality and quantity, users and livelihoods
- 2) To contribute to river basin planning, management and development





# Keynote presentation 5: Bio-monitoring team (Lao and English)



River Basin Knowledge Workshop  
29 September-1 October, 2014



## Demonstration on Bio sampling



### ຈຸດປະສົງ

- ແນະນຳວິທີການເກັບຕົວຢ່າງ ສັດບໍ່ມີກະດູກສັນຫຼັງ ແລະ ປາ ໃຫ້ແກ່ຜູ້ເຂົ້າຮ່ວມ



### ຈຸດເກັບຕົວຢ່າງ

1. ຝຸ່ນເຂດລະເບີດຫີນຂອງບໍລິເວນຊົມຊື່ນ



2. ຝຸ່ນເຂດລະເບີດຫີນຂອງບໍລິເວນຊົມຊື່ນ



## Keynote presentation 6: Community Base bio-monitoring (English)



**River Basin Knowledge Workshop**  
29 September-1 October, 2014



# COMMUNITY-BASED BIOMONITORING



**Presenters:**  
**1. Mr. Sinsamout Ounboundisane, Fisheries Biologist**  
**2. Mr. Phonesavanh Lorkhamheang, Project Technician**

### Community-Based Research (Primary Data Collection)

**What?**  
Community Members = Researchers  
(not just respondents)

**Why?**

- ▶ Local knowledge
- ▶ Long-term, up-to-date data
- ▶ Community awareness and participation



### River Basin Knowledge

Secondary Data	Primary Data
• Census	• Meetings
• Databases	• Interviews
• Maps	• Surveys



# Rapid Field Socio-economic and Water Resources related Livelihood Survey

## Objectives

- To collect data and develop an understanding on livelihood/occupations, income, and well-being status of communities in relation to water resources
- To understand how communities use water resources
- To predict future trends of communities' water resources and their uses

## Step 1

- Survey and identify village samplings
- Identify key criteria in selecting village samplings
- The sampling criteria must be able to represent key water resources issues as well as the issue of upstream and downstream impact



# **Training Manual for IWRM - Ecosystem Based Approach: Exchange Visit and MONRE Demonstration Site Proposal Development**





# I. Fact Sheet

Name of training course:	<b>IWRM- Ecosystem Based Approach: Exchange Visit and MONRE Demonstration Site Proposal Development</b>
Level and specialty:	Medium level and on-the-job based training
After the training, the trainees will:	<ol style="list-style-type: none"><li>1. Have broader perspectives and approaches for developing IWRM in watersheds, and be able to give an immediate potential for application in the Pilot Site of the Demonstration Center.</li><li>2. Understand key principles and specificities in IWRM applied in watersheds, especially the key role to be given to the population living in the Demonstration Center areas.</li><li>3. Be able to identify areas that may bring high value added for ecosystems protection.</li><li>4. Be able to identify particular needs in terms of knowledge and monitoring: identification of the ecosystems and related natural resources, impacts of human activities, services provided, value of the services provided.</li><li>5. Be able to identify particular approaches in terms of water and water related resources dialogue with the stakeholders, knowledge sharing, specific awareness tools, community monitoring, and local governance.</li></ol>
Target groups:	Department of Water Resources at Central and Vang Vieng district level, and communities within the MONRE IWRM Demonstration Site located in Vang Vieng district
Number of training days:	6.5 days
Dates and venue of training:	This Study Tour and Proposal Development Workshop were already conducted in northeast Thailand on 14-17 December 2014, and Vang Vieng District, Vientiane Province, Laos on 21-23 December 2014, accordingly.
Number of trainees:	14 Trainees (3 women and 11 men)
List of trainees:	See Annex A-4
List of principal trainers:	Mr. Bounsamong Fongnaly, Training and Awareness Building Unit Director, Department of Water Resources Dr. Yanyong Immoung, Dean, Faculty of Health and Social Science, Khon Khaen University Dr. Rachapaj Ratanawara, Director, Department of Water Resources Research Center, Rachamangkhal University of Technology Isan Mr. Suparerk Janprasart, Chief Technical Advisor and Team Leader

#### Training methodologies:

The training was divided into two main parts which are study tour and proposal writing workshop.

- Keynote presentations and interactive discussions prepared by the trainees themselves
- Keynote presentations and interactive discussions prepared and facilitated by trainers
- In-depth interview with governmental officers and local stakeholders
- Study tours of successful communities
- Proposal write shop

#### Training materials:

1. Situation Analysis, Training Concept and Training Modules
2. Training Program Agenda with Training Methodologies
3. Keynote Presentations
4. Summary Report

#### Recommended additional reference materials:

Ecosystem Management: Lessons from around the World. A Guide for Development and Conservation Practitioners

<https://portals.iucn.org/library/efiles/edocs/2000-051.pdf>

#### Training assessment results and findings:

**IWRM Ecosystem Based Approach: Exchange Visit** was organized in Northeastern part of Thailand on 14-17 December 2014, and **MONRE Demonstration Site Center Proposal Development Workshop** was organized in Vang Vieng District on 21-23 December 2014 accordingly. There were 14 trainees participated for both the exchange visit and the proposal development workshop. The trainees include representatives from central unit of DWR, representatives from Vang Vieng District and head of the villages that are located in the MONRE demonstration site in Vang Vieng. The exchange visit and the proposal development workshop are the follow-up training that were developed based on the findings from IWRM Frameworks training that held in central part of Lao PDR. The trainees of the IWRM Framework Training had requested another set of training that would enhance their understanding on how IWRM principles can be participatory adopted at community level with support and recognition from the central administration.

The exchange visit to successful pilots of local IWRM Ecosystem-based communities in Thailand was conducted. As a follow-up activity that would allow the trainees to apply the knowledge learnt from the exchange visit, the workshop was organized as a platform for the trainees to develop some ideas for the development of MONRE's demonstration site to be located in Vang Vieng district. The documents prepared during the workshop can be used to request for further funding.

Training assessment results and findings:

The exchange visits in Thailand included the visit of Thai Irrigation Department and Chi River Basin Organization office, organic vegetable garden communities, community tourism and local water and land use management. The trainees reported high satisfaction for all the visits, and have shown enthusiasm in exchanging ideas on how they could adopt what they have learned to improve the livelihood and water conservation efforts in their villages and communities.

The proposal workshop that was organized in Vang Vieng also appeared to be engaging. There were many active discussions, which were mainly initiated by the community representatives and local officers. The trainer team had collected all the notes and information and organized it into a brief report to be used as draft proposal preparation. It was agreed that the structure of the proposal should include six key areas of activities which are: 1) Livelihood improvement; 2) Community forest and water conservation; 3) Innovative community tourism, 4) Capacity building and research, 5) Local networking and 6) Facility development.

Next steps and Recommendations:

Continue to organize the proposal and identify potential donors.



## II. Situation Analysis, Training Concepts and Training Modules

### A. Justification

“Integrated Water Resources Management (IWRM) is a process which promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment”<sup>9</sup>. This general concept was developed in a first training on IWRM framework organized in May 2014. Actually, this training has created a demand from the officials and stakeholders in Nam Ngum Basin to tackle more specifically the topic of “sustainability of vital ecosystems” by boosting IWRM-ecosystem based activities to be demonstrated in Vang Vieng in the MONRE-DWR Demonstration Site.

It is widely recognized that, within large river basins like Nam Ngum, in which trade off must be found for boosting socio-economic development while maintaining sustainable water and water-related environmental resources, there is a need to focus on areas which are expected to play a particular role for sustaining healthy ecosystems, maintaining good water quality (both surface and groundwater) and smoothing flash flood and drought. These areas actually provide what it is now commonly called “Ecosystem Services”.

Some areas, like National Park or Conservation Areas in which generally no human activities (or limited human activities) are allowed have their own legal framework and management rules. They have been identified for their exceptional value in terms of bio-diversity, wildlife and value of forest. These areas obviously greatly contribute for maintaining vital ecosystems in the river basin.

But other areas that have not such level of protection and in which usual settlement and human activities are encountered, may also contribute significantly to sustain ecosystems and environment. These areas may be for example: (i) upper-watersheds where water, soil and forest must be carefully protected for mitigating soil erosion, sediment transport, eutrophication of reservoirs located downstream and for maintaining high quality of freshwater; (ii) wetlands and river

embankments that provide rich and diverse ecosystems and contribute to sustain groundwater and minimum flows; (iii) flood plains where large flood can be buffered decreasing the risks of damage for human lives and infrastructures.

Protecting such ecosystems participates directly to the economic and social development of a river basin. Ecosystems have actually an economic value that must be taken into account in the global trade-off and that justify investments and specific management rules. The “services” provided by the ecosystems may be:

- Provisioning services: the products obtained from ecosystems such as food, fresh water, wood, fiber, genetic resources and medicines.
- Regulating services: benefits obtained from the regulation of ecosystem processes such as climate regulation, natural hazard regulation, water purification and waste management, pollination or pest control.
- Habitat services: habitat for migratory species and to maintain the viability of gene-pools.
- Cultural services: non-material benefits that people obtain from ecosystems such as spiritual enrichment, intellectual development, recreation and aesthetic values.

It is therefore essential that the water resources managers, at central and decentralized levels, recognize the importance of the ecosystems services, proceed to an identification of the areas where to focus specific activities of protection or restoration and take long term measures for adequate management. Ideally this should be part of the key functions of a River Basin Organization (RBO) i.e. Nam Ngum.

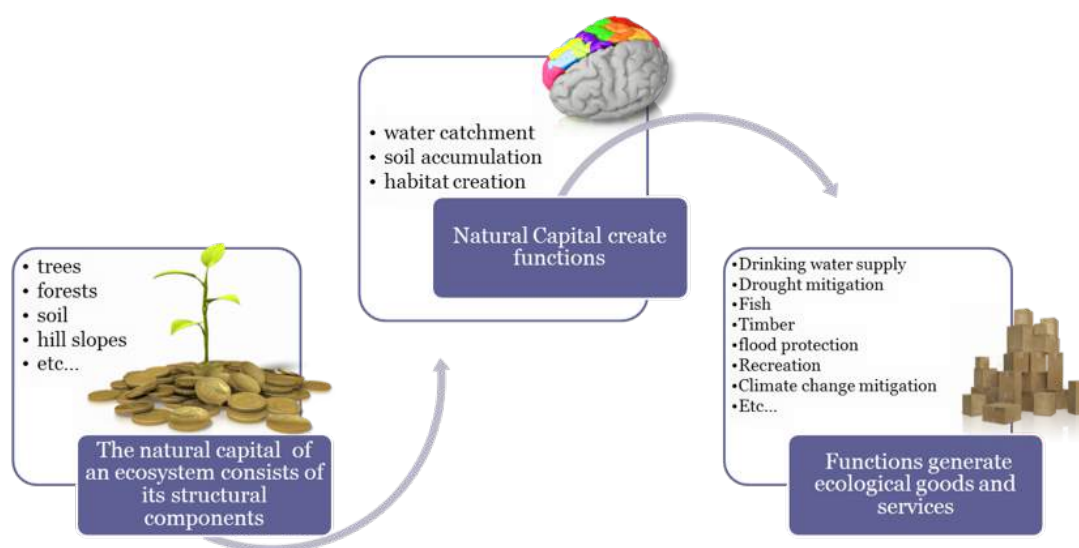
IWRM principles are a particularly well adapted tool for supporting the protection of such vital ecosystems as it is for river basin management in general. This means that it is necessary to get the stakeholders together to identify the issues (where we are ?), trying to sort out a common vision (where we want to go?) and a mutually agreed road map and the related action plans (how do we get there?).

9. Global Water Partnership: <http://www.gwp.org/The-Challenge/What-is-IWRM>

IWRM-Ecosystems based approach presents some specificities, the likely most relevant being:

- The areas selected as “vital ecosystems” are generally geographically limited (small watershed, wetlands, etc.). It is therefore generally a “community/villagers-driven” context.
- The central government and decentralized agencies have an important role to play for providing assistance and safeguards. Nevertheless, the key stakeholders and the guarantors of the good health of the ecosystems and environment are the people living in the area. Therefore, positioning the villagers at the center of the IWRM-Ecosystems dialogue and coordination and recognizing the importance of good local governance in each step of the process is a pre-requisite.
- It is important to get a good knowledge of the ecosystems and natural resources to be protected in order to propose adequate road map and actions. These ecosystems should be also inserted into the context of the services they may provide for contributing to the sustainability of vital ecosystems and the environment at river basin level. A good knowledge on the impacts of human activities on these eco-systems is also essential for supporting the decision process.
- Apprehending the value of the services provided by the vital ecosystems may then help establishing mechanisms for ensuring the long term sustainability of the actions taken. This may even conduct to envisage “Payment for Ecosystem Services” that may be good incentive for the stakeholders and a tool for sustainability.

	River Basin	Watershed
Hydrology	All the water drains to a large river	Smaller area of land that drains to a smaller stream, lake or wetland
Stakeholders	Wide range of various stakeholders	Humans settlement that simple logic demands they become part of a community
Functions	Contribute to the sustainable socio-economic development at nation or regional level	Providing ecosystems services that sustain the global and local socio-economic development
Management	Provincial/national/regional level	“Communities driven”/local level (districts/communities)
Sustainability	Government funds/funding agencies	Local funds/local taxes Government incentives Payment for ecosystem services





Promoting IWRM-Ecosystems in watersheds is an opportunity to step-wisely boost the engagement of the communities in the overall River Basin IWRM process, creating local capacity and leadership. It may eventually greatly contribute to a more seamless collaboration between the government agencies and communities.

It is in this context that MONRE/DWR has initiated a "Demonstration-IWRM training Center" in Vang Vieng. The Center has been established for two years while the activities undertaken are mostly at early stage. This is the very first ever of IWRM-Ecosystem based demonstration site of Laos. The activities of the Center include:

- Training facilities
- Venue for river basin management exhibition
- Demonstration or "Pilot Site" for IWRM activities at community levels in different important areas of water management.

The National MONRE's Demonstration-IWRM Training Center is located on the Nam Pao River. The "Pilot Site", covering an area of 829 ha, is an upper-watershed which is largely constituted of headwater rainforest which is mostly in pristine condition. There are five villages located within the Pilot area inhabited by mixed ethnic groups: high-middle-lower Laotians. The local residents live on rice farming and non-timber products harvesting. Local flora and fauna communities in the project area characterize distinct headwater rainforest biota while rare native species are abundant with high biodiversity of national importance. The Center is also co-inhabited by five villages of mixed ethnic groups; low-middle-high Laotians.

The activities in the Pilot Site, at early stage, were conducted jointly by the central-provincial-district governments in partnership with local communities. The activities are strategically designed to support the local communities in playing a proactive role in implementing conservation actions in their localities. Many activities are therefore managed and implemented by these communities, these include:

- Exploring physical and biological settings of the project area, fencing of the project area boundary, initially survey of the stream morphology and the local fauna and flora.

- Building and renovating a weir and check dam.
- Establishing and providing waterfall water supply system for the villagers.
- Reforestation and organization of community involvement activities.

The vision that leads to the expected development of Pilot Site's activities is the highlighting of the key role and benefit of local engagement to contribute to the sustainability of water and environmental conservation, local livelihood and local's wellbeing. The success stories and lesson learn of the Pilot Site will be disseminated and upscale across every basin of Laos.

In a next step, it is planned to develop and consolidate the potentiality of the "Demonstration-IWRM Training Center" focusing on the following areas

- Develop the facilities of the Center to fit with the objective of being a Center for Exhibition Events on topics related to water management, a Venue for meeting and seminars and an Awareness Center with permanent exhibition material on the importance to protect the watersheds ecosystems (that would be also visited by tourists to get them more familiarized with the Lao nature richness)
- Promote local livelihood i.e community forest management, sustainable agriculture, water quality management, fisheries conservation zone, community tourism.
- Develop capacities in local water quality monitoring and risk management (e.g. floods warning).

The University of Khon Khaen, Thailand (KKU) has been identified as a suitable partner to bring advises and technical support for the development of the potentialities of the Center. KKU is located in North-East of Thailand and is involved in watersheds which share similar physical, social and cultural features of the Mekong eco-region.

The present training has 2 parts:

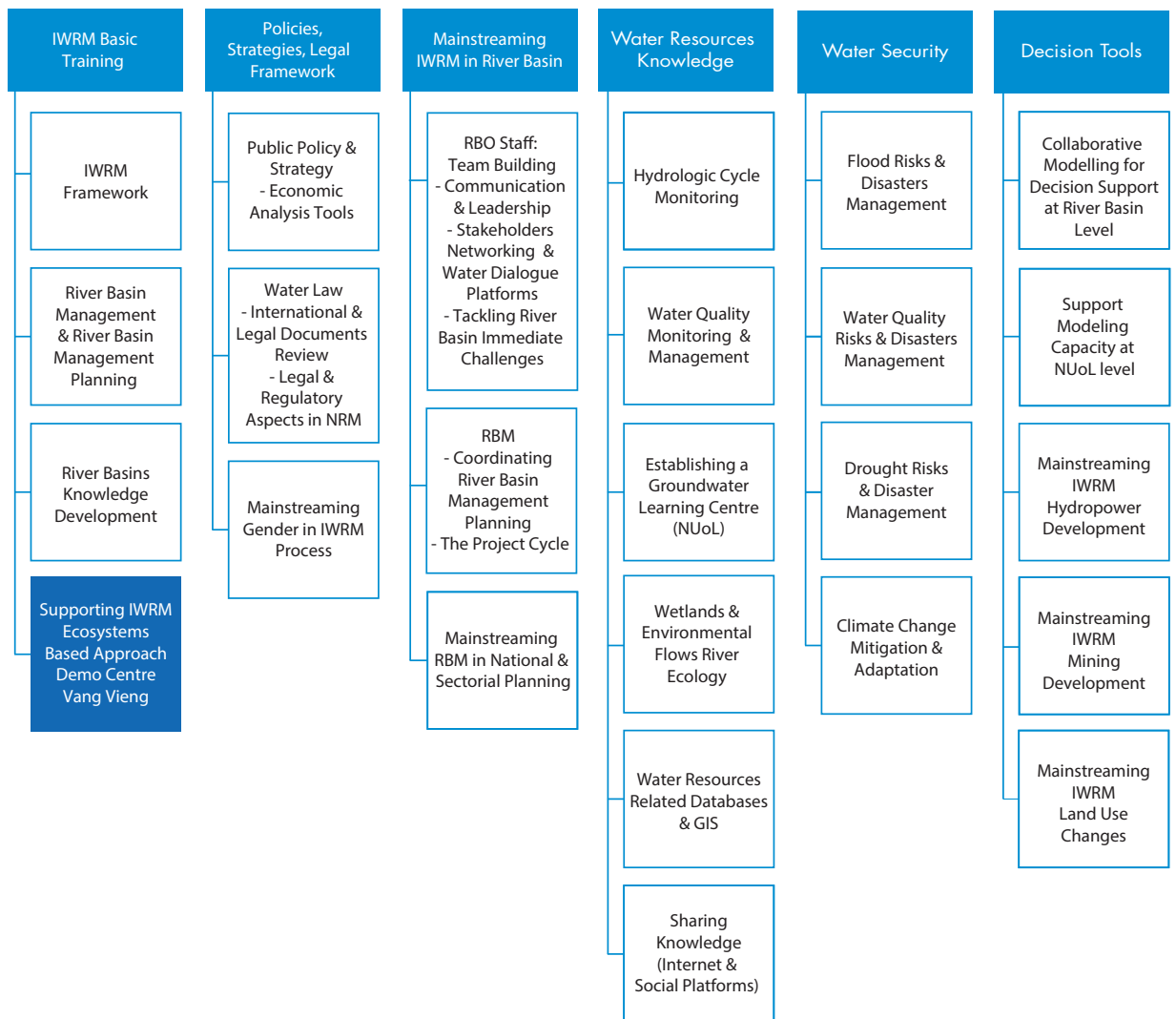
- **Part 1: Exchange study tour** organized by KKU will bring the trainees to visit these type of successful cases in NE Thailand and encourage them in considering new ideas and approaches that could be proposed in the Pilot Site of the Vang Vieng Demonstration site. The exchange visit must also contribute to a better understanding of the specificities of applying IWRM-Ecosystems based approach in a “community-driven” context for protecting vital ecosystems and related natural resources.

- **Part 2: Visit of the Demonstration Center in Vang Vieng**

- Wrapping up from the participants of the exchange visit in Thailand of the outputs of their visit, the lessons learnt and the potential they have discovered that could be applied in the Pilot Site.
- Review the potentialities and areas for supporting the development Demonstration Center in Vang Vieng and sort out a concept and development plan that would be presented for consideration to potential partners that could support the Center in a longer perspective after completion of ADB TA7780<sup>10</sup>.

The next figure allows to localize this module within the framework of the Training Plan:

**Figure 11: Training Plan Organization Chart**



10. It is agreed with WBIWRM project that they will take on for the consideration of funding and implementation after ADB TA7780 would have been completed.

## B. Expected Outputs

The expected outputs are:

### Part 1: Exchange study tour

- From exchange with Thai communities, villagers and WR agencies, the trainees get broader perspectives and approaches for developing IWRM in watersheds. It gives them an immediate potential for application in the Pilot Site of the Demonstration Centre
- The trainees understand key principles and specificities in IWRM applied in watersheds, especially the key role to be given to the population living in the targeted areas;
- Trainees are able to identify areas that may bring high value added for ecosystems protection.
- Trainees are able to identify particular needs in terms of knowledge and monitoring: identification of the ecosystems and related natural resources, impacts of human activities, services provided, value of the services provided.
- Trainees are able to identify particular approaches in terms of water and water related resources dialogue with the stakeholders, knowledge sharing, specific awareness tools, community monitoring, local governance.

## C. Main Topics Covered

The topics that will be covered are listed below:

### During the exchange visit trip in Thailand (Part 1)

- What is generally behind the concept of “Vital Ecosystems”?
- Criteria for selecting an area where the concept of protecting “vital ecosystems” is expected to be applied (hydrological criteria, environmental criteria, socio-economic context, existing “leadership”, etc)?
- What are the specific ecosystems and/or water/natural resources to be protected and what are the “services” they may provide for contributing to maintain environmental sustainability and socio-economic development and welfare within the perspective of the overall river basin?

- How these eco-systems may be impacted by human activities and socio-economic development?
- How IWRM principles may be applied to manage these areas and what are the specificities when applying these principles, with emphasis on the key role of the population living in the areas?

### During the workshop at the MONRE/DWR’s Demonstration Center in Vang Vieng (Part 2)

- Develop an action plan based on the following topic:
  - **Identification of the needs to make the Center a place of excellence** to organize exhibitions and seminars about Water Resources Management
  - **Identification of the needs in Knowledge and Monitoring – What would be the community engagement in contributing to the knowledge and Monitoring:** Getting a good knowledge of the area covered by the MONRE/DWR demonstration center (“Profile”). Evaluate up to what point this knowledge is adequate and what should be done to improve it (focusing on the concept of vital ecosystems, the services they may provide and the impacts of human activities on these ecosystems)
  - **Identification of the needs to reinforce Communities/Stakeholder’s capacity, involvement, leadership and coordination:** Evaluate the status of the dialogue with the stakeholders: consensuses on issues, shared vision, road map.
  - **Identification of the needs for improving Local Governance Tools:** Evaluate the needs for improving governance tools such as: community tools for decision process, communication with RBC/Agencies, knowledge sharing, community monitoring, risk management, awareness, etc.

## III. Training Program Agenda

### A: IWRM- Ecosystem Based Approach: Exchange Visit in Northeast, Thailand

#### Day 1

Time	Program	Resource Person
<b>Exchange Visit Session 1: Introduction</b> <b>Objectives:</b> To give an overview picture of Thailand Water Resources Management and the program agenda of the visit in the next three days		
10:00	Travel to Khon Khaen, Thailand	
15:30	Arrive at Khon Khaen, Thailand	
16:00-16:30	Welcome remarks	Director DWR Region 4, Thailand, and Khon Khaen University, Health and Social Science
16:30-17:00	Briefing: the Chi River Basin - basic facts, Thailand IWRM management strategy <ul style="list-style-type: none"> <li>• Thailand river basin legal system.</li> <li>• River basin management framework.</li> <li>• Institutionalization of Thailand River Basin Organization (RBO).</li> <li>• The role and function of RBO.</li> <li>• Limitation and barrier of Thailand RBO.</li> <li>• IWRM concepts and key practices of the pilot sites.</li> </ul> And site visits in the next three days <i>Keynote presentation 1 (English)</i>	Director DWR Region 11, Thailand
17:00-17:30	<b>Briefing: river basin information management system</b> <ul style="list-style-type: none"> <li>• Application of GIS and webpage for watershed information management.</li> <li>• One page mapping strategy for public communication in the watershed.</li> <li>• Inventory and application of telemetry system in assisting watershed conservation and management.</li> </ul> <i>Keynote presentation 2 (English)</i>	Mekong Research Center, Technology Rachamangkhal University
17:30-18:00	Q&A	Khon Khaen University, Health and Social Science
18:00-20:00	Reception dinner	

## Day 2

Time	Program	Resource Person
<b>Exchange Visit Session 2: Water Management Facilities and Exhibition</b> <b>Objectives:</b> The trainees will visit the northeast irrigation and water management center and be shared experience from Thailand on collaborative flood and irrigation management		
08:00-08:30	Depart hotel to Khon Khaen Irrigation Department Information Center	
08:30-09:00	Welcome Address and Introduction of Khon Khaen Irrigation Department Information Center	Director, Irrigation Department, Region 4
09:00-10:30	Visit the Center Exhibition	Director, Irrigation Department, Region 4
10:45-11:00	Refreshment	Admin team
11:00-12:00	River Basin Organizations in Northeast Thailand and experience on collaborative flood and irrigation management between government, NGOs, private sectors and water user groups. <ul style="list-style-type: none"> <li>• Briefing on water allocation system in the irrigated farmlands.</li> <li>• Application of WEAP and CropWat programs in water management and planning within the watershed.</li> <li>• Direct observations on water allocation system</li> </ul> <i>Keynote presentation 3 (Thai)</i>	Irrigation Department, Region 4, irrigation management expert
12:00-13:00	Lunch	
<b>Exchange Visit Session 3: Self-sufficient economy and chemical free agriculture</b> <b>Objectives:</b> The trainees will visit a success community on integrated farming practice and exchange lessons and knowledge		
13:00-16:00	Depart to Kalasin Province, visit the 'Community Rice Seed Production Center' at Huay Po Sub-District, Muang District (2 hours)  The Center delivers activities: <ul style="list-style-type: none"> <li>• Bioherbal pest control,</li> <li>• Plant hormone,</li> <li>• Renewable energy,</li> <li>• Integrated pest management,</li> <li>• Mixed farm-base productions.</li> </ul>	Khon Khaen team
<b>Exchange Visit Session 4: Community Tourism</b> <b>Objectives:</b> The trainees will visit and stay in a NE Thailand, award winning community on community tourism. The trainees will have opportunities to learn about local tourism management that led and managed by the members of the community themselves		
16:00-17:30	Arrive at Ban Kok Gong, Kuchinarai District  Welcome address by the community leader  Meet the home-stay hosts	Khon Khaen team
18:00-21:00	Reception dinner	Khon Khaen team



Time	Program	Resource Person
21:00	Stay overnight at Ban Kok Gong (home stay), Kuchinarai District	

### Day 3

Time	Program	Resource Person
07:00-09:30	Enjoy morning special moment at Ban Kok Gong <ul style="list-style-type: none"> <li>• Cook breakfast with the home-stay host</li> <li>• Offer food to the Buddhist monks</li> <li>• Breath taking at the local waterfalls</li> <li>• Have breakfast with the hosts</li> <li>• Cultural performance and dinning management</li> <li>• Household accommodation and in-house activities management</li> </ul>	Khon Khaen team

#### Exchange Visit Session 5: Community-based Water and Land Management

**Objectives:** The trainees will visit a successful and award winning community in local water management. The community has been long facing chronic drought problem but however, has recently coped with the problem very efficiently by adopting integrated smart land use planning and farming system.

09:30-10:15	Depart to Sai Na Wang Sub-District, Nakoo District (50 kms from Ban Kok Gong)	
10:15-12:00	Briefing: community water management and integrated farming practices in dryland	Chief of the village
12:00-13:00	Lunch at Sai Na Wang	Ms. Siripak and the team
13:00-16:00	Experience: integrated farming systems at Mr. Bumroong farmland <i>Keynote presentation 4</i>	Mr. Bumroong Kayota, a farmer
16:00-18:30	Depart from Sai Na Wang Sub-District to Khon Khaen Province	
18:30	Stay overnight at hotel in Khon Khaen Province	

### Day 4

Time	Program	Resource Person
<b>Exchange visit session 6: Wrap Up and Reflection</b> <b>Objectives:</b> Reflection session and to discuss on a preparation of the next week trip in Laos, IWRM Eco-system based Approach Proposal Development		
08:30-09:00	Q&A with lessons learnt	Khon Khaen University
09:00-10:00	Discussion of future collaborations	Khon Khaen University
10:00-10:30	Coffee break plus Q&A	
10:30	Depart to Vientiane Lao PDR	

## B: MONRE's Demonstration Site Proposal Development Workshop

### Day 1

Time	Program	Resource Person
<b>Session 1: Demonstration Site Visit and Local Interviews</b>		
10:00	Meet KKU team at Laos-Thai Border and depart to Vang Vieng	DWR and KKU
12:00-13:00	Lunch on the way at Vientiane Capital	
16:00	Arrive Vang Vieng Demonstration Site, met with Community representatives	
18:00	Travel to Vang Vieng and check-in to hotel	

### Day 2

Time	Program	Resource Person
<b>Session 1: Introduction of the Workshop and Recap</b>		
08:30-09:00	Opening and introduction <i>Keynote presentation 5</i>	DWR
09:00-09:30	Recap, objectives, expected output and methodology	CTA
09:30-10:00	Small plenary discussion	CTA
<b>Session 2: Warm up and Pilot Activity Brainstorming</b> <b>Objectives:</b> To collect inputs on possible activities to be developed in the MoNRE's Demonstration Site		
10:00-10:45	Warm-up. Ideas brainstorming of pilot activities for the demonstration site	KKU/village representatives
10:45-11:00	Break	
11:00-12:00	Proposal and action plan methodology Discussion	KKU/village representatives
12:00-13:00	Lunch	Admin
13:00-15:00	Group discussion on activities grouped into (if possible) <ul style="list-style-type: none"> <li>• Facility and exhibition management,</li> <li>• Sustainable livelihoods i.e non-chemical agriculture, local energy production, fisheries conservation and community tourism</li> <li>• Local based water and land use management</li> <li>• Community research</li> </ul>	DWR/KKU/CTA and village representatives
15:00-15:15	Break	
15:15-16:30	Continue group discussion and report to plenary	

## Day 3

Time	Program	Resource Person
<b>Session 3: From Ideas into Proposal and Action Plan Development, and Commitment Building</b> <b>Objective:</b> Proposal workshop, to drawing structure and outlines of the proposal		
08:30-09:00	Recap	CTA
09:00-10:45	Development of proposal and action plan <ul style="list-style-type: none"> <li>• Background</li> <li>• Objectives and outcomes</li> <li>• Budget and timeframe</li> <li>• Pilot activities</li> <li>• Concerned agencies and communities</li> <li>• Fund raising plan</li> <li>• Ways forward</li> </ul>	KKU/village representatives
10:45-11:00	Break	
10:45-12:00	Continued: Development of proposal	KKU/village representatives
12:00-13:00	Lunch	
13:00-16:00	Group workshop on their proposal activity and Reporting to plenary	KKU/DWR/CTA
15:00-15:15 break	Commitment building and future plan <i>Document 1: Summary Report</i>	
16:00-16:30	Closing and travel back home	DWR








## Keynote presentation 2: Water and Database management by Telemetry Equipment (English)

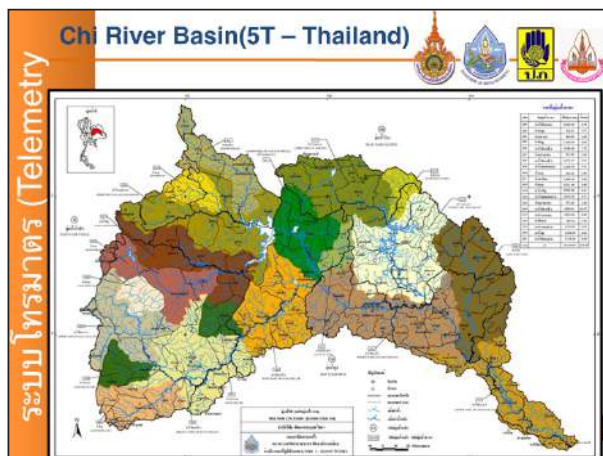

ระบบโทรมาตร (Telemetry System)



### Telemetry System (ระบบโทรมาตร)

Develop an information decision support system.

**RMUTI**  
**Rajamangala University of Technology Isan**  
**:Khonkaen Campus**





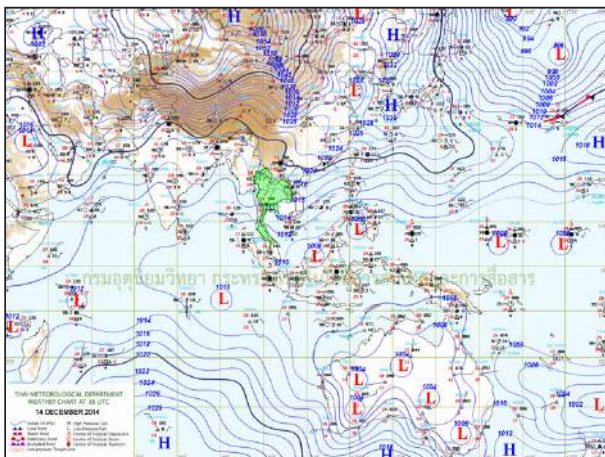
# Keynote presentation 3: Water Management by Royal Thai Irrigation Department (Thai)

สำนักงานชลประทานที่ ๖ กรมชลประทาน  
Royal Irrigation Department

## ยินดีต้อนรับ คณะเจ้าหน้าที่ สาธารณรัฐประชาธิปไตย ประชาชนลาว

สาขาละมะลัดปะชาทิปะไตปะชาธิบลาว

### โครงการส่งน้ำและบำรุงรักษาหนองหวาย Nong Wai Operation and Maintenance Project



บริเวณความกดอากาศสูงกำลังค่อนข้างแรงจากประเทศจีนที่ปกคลุมประเทศไทยตอนบนเริ่มมีกำลังอ่อนลง ประกอบกับมรสุมตะวันออกเฉียงเหนือกำลังแรงยังคงพัดปกคลุมภาคใต้และอ่าวไทย ลักษณะเช่นนี้ทำให้ภาคใต้ตอนล่างมีฝนอยู่ในเกณฑ์กระจาย และมีฝนตกหนักบางแห่ง สำหรับคลื่นลมบริเวณอ่าวไทยตอนล่างยังคงมีคลื่นสูง 2-3 เมตร ขอให้ชาวเรือในบริเวณดังกล่าวเดินเรือด้วยความระมัดระวัง และเรือเล็กตั้งแต่จังหวัดสุราษฎร์ธานีลงไปควรออกจากฝั่งอีก 1 วัน (15 ธ.ค. 57) และขอให้ประชาชนบริเวณจังหวัดสุราษฎร์ธานี นครศรีธรรมราช สงขลา และนราธิวาส ระวังอันตรายจากฝนที่สะสมไว้ด้วย

# การบริหารจัดการทรัพยากรน้ำชุมชน

โดย

คณะกรรมการบริหารจัดการน้ำแบบบูรณาการตำบลสายนาวัง  
อำเภอนาคว จังหวัดกาฬสินธุ์

1

## ข้อมูลพื้นฐาน

ลักษณะภูมิประเทศของตำบลสายนาวังเป็นที่ราบสูง พื้นที่เพาะปลูกส่วนใหญ่เป็นที่นาดอน ลักษณะดินเป็นดินร่วนปนทราย ในเขตพื้นที่ตำบลสายนาวัง ใช้ที่ดินสำหรับการเพาะปลูกเป็นส่วนใหญ่ ประมาณร้อยละ 60 ของพื้นที่ทั้งหมด ที่เหลือจะเป็นที่อยู่อาศัยและที่สาธารณะ การใช้ประโยชน์ของที่ดินซึ่งใช้ไม่ได้เต็มที่เนื่องจากดินส่วนมากจะเป็นดินปนทราย และยังมีขาดแคลนน้ำ มีลำห้วยที่สำคัญ คือ ห้วยมะโน ห้วยสายนา ห้วยหนองเม็ก ห้วยกุดแฮ่ ห้วยน้ำขุ่น

พื้นที่เกษตรทั้งหมด 7,792 ไร่ หรือ 16.10 ตร.กม

จำนวนประชากร 4,122 คน  
แยกเป็น ชาย 2,036 หญิง 2,086

ร้อยละ 90 ของครัวเรือนประชากร  
ประกอบอาชีพเกษตรกรรม

มีจำนวน 8 หมู่บ้าน  
บ้านจอมศรี หมู่ที่ 1  
บ้านหนองขามป้อม หมู่ที่ 2  
บ้านนาทุสม หมู่ที่ 3  
บ้านกุดตาโกศล หมู่ที่ 4  
บ้านนากระเตา หมู่ที่ 5  
บ้านนากระเตาพัฒนา หมู่ที่ 6  
บ้านกุดตาโกศลพัฒนา หมู่ที่ 7  
บ้านนาทุสมพัฒนา หมู่ที่ 8

2

## ข้อมูลพื้นฐาน



บริหารจัดการน้ำเพื่อการเกษตรด้วยระบบ  
เหมืองฝาย

- ♦ จำนวนเกษตรกรที่ใช้ประโยชน์จากฝาย 82 คน
- ♦ พื้นที่การเพาะปลูกในฤดูฝน 483 ไร่ 2 งาน
- ♦ พื้นที่การเพาะปลูกในฤดูแล้ง 255 ไร่
- ♦ พืชที่ปลูกในฤดูแล้ง ได้แก่ ข้าว ยาสุม ถั่วลิสง  
แดงไหม แดงกวาง และมันสำปะหลัง

3



# Keynote presentation 5: MoNRE IWRM Demonstration Site (Lao)



## ການສ້າງສວນສາທິດ ແຫ່ງຊາດ ກ່ຽວກັບ ການຄຸ້ມຄອງຊັບພະຍາກອນນໍ້າ ແບບປະສົມປະສານ ທີ່ ອ່າງແມ່ນໍ້າອ່ອຍ ນໍ້າເປາະ, ເມືອງ ວັງວຽງ, ແຂວງ ວຽງຈັນ

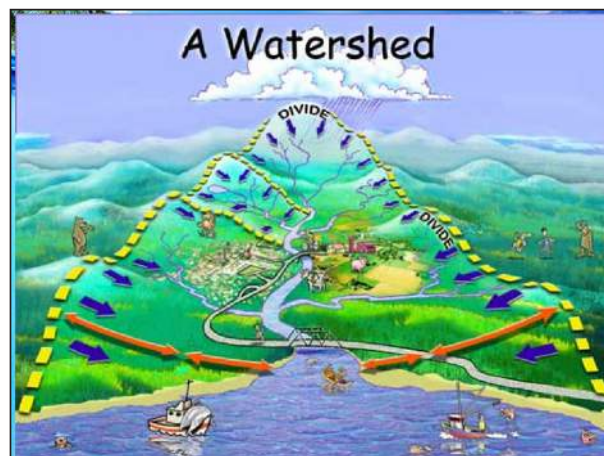
ສະເໜີໂດຍ: ແສງພະສຸກ ໄຊຍະວິງ  
ກົມຊັບພະຍາກອນນໍ້າ

**ບ່ອນອີງໃນການສ້າງສວນສາທິດ:**

ຂໍ້ຕົກລົງ ວ່າດ້ວຍ ການຈັດຕັ້ງ ແລະ ການເຄື່ອນໄຫວ ຂອງ ກົມຊັບພະຍາກອນນໍ້າ ສະບັບເວກທີ 308/ ກຊສ ວົງວັນທີ 17 ພຶດສະພາ 2012, ເມດຕາ 12, ຂໍ້ 12.4 ສ້າງ ແລະ ຄຸ້ມຄອງ ສວນສາທິດແຫ່ງຊາດ ກ່ຽວກັບ ການຄຸ້ມຄອງ ຊັບພະຍາກອນນໍ້າ ແບບປະສົມປະສານ ເພື່ອຮັບໃຊ້ແກ້ ການພິດພາດນໍ້າ ເປັນບ່ອນສຶກສາຄົ້ນຄວ້າ ຂອງ ນັກຮຽນ-ນັກສຶກສາ ການທົດສະນະສຶກສາແວກປ່ຽນ ບົດຮຽນ ແລະ ເປັນບ່ອນສ້າງຈິດສາມັກ.

ອ້າງເຖິງ ຜົນສໍາເລັດຂອງການຄຸ້ມຄອງຊັບພະຍາກອນນໍ້າ ແຫ່ງຊາດ ແຕ່ປີ 2020 ແລະ ແຜນດໍາເນີນງານ 2011-2015 ຊຶ່ງ ໄດ້ສະເໜີຜ່ານກອງປະຊຸມວັດຖະບານສະໄໝສາມັນ ປະຈໍາເດືອນ ພຶດສະພາ 2011, ສະບັບເວກທີ 05/ ວປ ວົງວັນທີ 8 ມິຖຸນາ 2011.

ແຜນການ ຂອງ ຂະແໜງການ ຊັບພະຍາກອນທໍາມະຊາດ ແລະ ສິ່ງແວດລ້ອມ ສົກປີ 2013-2014 ສະບັບເວກທີ 885/ ກຊສ ວົງວັນທີ 20 ມີນາ 2013 ໃດ້ແມັງ 3.1, ຂໍ້ 7 ສືບຕໍ່ສຶກສາ ແລະ ອອກແບບ ສ້າງສວນສາທິດ ການຄຸ້ມຄອງ ຊັບພະຍາກອນນໍ້າ ແບບປະສົມປະສານ ທີ່ເມືອງວັງວຽງ ແຂວງວຽງຈັນ.



## Document 1: Summary Report on IWRM Knowledge and Practice Exchanges between Lao PDR and Thailand

Summary Report on  
IWRM Knowledge and Practice Exchanges between Lao PDR and Thailand



By

Yanyong Inmuong  
Rachapat Ratanawaraha  
Prasit Warnset  
Aschara Booppapun

**December 2014**

1

# **Training Manual for Participatory Flood Risks Management**





# I. Fact Sheet

Name of training course:	<b>Participatory Flood Risks Management</b>
Level and specialty:	Medium and on-the-job based training
After the training, the trainees will:	<ol style="list-style-type: none"><li>1. Understand basic knowledge and characteristic of floods and droughts, their associated risks and opportunities</li><li>2. Be able to identify impacts, key stakeholders, and mitigation priorities on the flood and drought risks in Xaybangfai Basin</li><li>3. Develop a multi-approach action plan and multi-stakeholder process for flood and drought mitigation in Xaybangfi</li><li>4. Build and be engaged in a multi-stakeholder flood risks network in Xaybangfai Basin</li></ol>
Target groups:	<p>This training was specifically designed for target trainees located in Nam Thuan and Xaybangfai Basins. The training's primary objective is to support the World Bank Mekong IWRM Project (WB-MIWRM) – Xaybangfai Flood Management Component.</p> <p>The trainees include:</p> <ul style="list-style-type: none"><li>• Governmental water agencies and staff at central, provincial, district and sub-district levels</li><li>• River basin organizations</li><li>• National University of Laos</li><li>• Hydropower operators</li><li>• Local communities and impacted groups</li></ul>
Number of training days:	3.5 days
Dates and venue of training:	This training was already conducted in Xaybangfai District, Khammouane Province, Xaybangfai Basin on 1-4 June 2015
Number of trainees:	60 Trainees (15 women and 45 Men)
List of trainees:	See Annex A-5
List of principal trainers:	<p>Mr. Bounsanong Fongnaly, Training and Awareness Building Unit Director, Department of Water Resources</p> <p>Mr. Somphone Kongsab, Head, Flood Management Unit, DWR</p> <p>Mr. Souksakorn Phouthamath, Technical Office, DWR</p> <p>Mr. Nancy Kim, Country Coordinator, The Asia Foundation</p> <p>Mr. Suparerk Janprasart, Chief Technical Advisor and Team Leader</p>

#### Training methodologies:

The training was divided into five different sessions which exploited different methodologies that include:

- Keynote presentations and interactive discussions prepared by the trainees themselves
- Keynote presentations and interactive discussions prepared and facilitated by trainers
- In-depth discussion on causes of flood risks and impacts
- Field trip and field exercise in local stakeholder interviews
- Small group exercises in the development of flood local flood mitigation and action plan
- Plenary presentation

#### Training materials:

1. Situation Analysis, Training Concept and Training Modules
2. Training Program Agenda with Training Methodologies
3. Keynote Presentations
4. Official Documents

#### Recommended additional reference materials:

1. The Role of Ecosystems in Disaster Risk Reduction  
<https://collections.unu.edu/view/UNU:1995#viewAttachments>
2. Floods: From Risks to Opportunities  
<http://www.icharm.pwri.go.jp/publication/book.html>

#### Training assessment results and findings:

This on-the-job training was designed to provide knowledge about flood risk characteristics, impacts and causes of flood, analyzed from both historical scientific data and the participants' own experiences. It was jointly organized by ADB-TA7780 NIWRMSP project team and WB-MIWRM Project (Xaybangfai Flood Management Component) project team. The 60 trainees participated in this training were representatives of different group from Nam Thuan and Xaybangfai Basins. These trainees include local impacted groups, provincial, private sectors and NGOs.

The training successfully provided participants the basic skill in flood risks observation and analysis, which can be adopted to their works in Nam Thuan and Xaybangfai Basins. The trainees collectively identified the causes of flood risks and impacts in Xaybangfai, which are associated from both natural and man-made activities. Xaybangfai is a water rich basin with high incidence rate for flooding. To add on to that, over the last ten years, hydropower development, abrupt land use change and upstream deforestation have exacerbated the issue, leading to increase the risk for flash flood, prolong the flooding period and cause significant impacts to the vulnerable communities. In addition to the increased risks for floods and its direct impact, worsened water quality, poor condition for fisheries and erosion were also presented as the major issues resulting from increased in flood risks.

Towards the end of the training, the trainees brainstormed and developed a constructive list of key action plan for local flood mitigation and management in Xaybangfai Basin. This action plan is expected to be further developed, led by the WB-MIWRM Project, Xaybangfai Flood Management Component. The overall score of this training rated by the trainees was **7.5 out of 10**.

Next steps and  
Recommendations:

1. Additional trainings in flood management and mitigation, stakeholder platform facilitation and SIA/EIA.
2. Organize the similar training once a year with the same trainee group as to update their local water situation and monitor progress of their water management skills, and to strengthen team building and networking.
3. Disseminate information of the activity to donors for fund raising purpose.





## II. Situation Analysis, Training Concepts and Training Modules

### A. Justification

The term “Water security” comprises three components: (i) “Too much water”: Flood risks management; (ii) “Not enough water”: Drought risks management; (iii) “Bad water quality”: water quality and health related risks management. These three components will be addressed in a series of modules on water security. Additionally, a specific module will be conducted on Climate Change adaptation and mitigation and impacts on water security policies and strategies. This concept note addresses the module related to the topic “Flood Risks Management”.

Flood is often mentioned as one of the most major concern for many river basins in Lao PDR. Every year, flood is reported in various areas of the country. Sometimes, it causes heavy damages and even cost human live. It is expected that more severe flood

events will occur in the future. Two main causes are suggested: (i) global climate change is disrupting the normal curves depth-duration-intensity of rainfalls making more probable severe rainfall events and (ii) de-forestation is listed as well as a major cause of flash flood especially in the upper-watersheds, which are very sensitive to change in land coverage, making runoff becoming a more important factor in the hydrological cycle. The change of land-use in urban and semi-urban areas is also a cause of worsening floods and worsening consequences on valuable economic infrastructures and family assets.

Flood risks present two different aspects in Lao PDR: (i) flash floods occurring in the tributaries of the Mekong. This means that water level is increasing rapidly, with high water velocity, but not lasting long. These situations are dangerous for people and animals, indeed little time is available for warning and security measures. (ii) Flood in floodplains, occurring along the Mekong river and at the confluence of the large tributaries are more pre-dictable, but is lasting much longer and may cause serious damage to crops. Combination of flash floods and high water level in the Mekong occurs as well in the lower part of the tributaries. Such areas are very prone for flood with high potential of serious damage for human life and people assets. Lower Xebangfai is one of the most reported examples of such events in Lao PDR.

It must not be forgotten that flood is not only a risk but also an opportunity. The major part of the agriculture in Lao PDR, mainly rice cultivation, and the fisheries activities and ecosystems are highly dependent from floods. This means that building infrastructures for flood control may also negatively affect these activities. It is why Flood Risk Management may comprises some hardware infrastructures in very specific areas (urban, very populated areas, protection of high-value economic assets), but must consider widely “soft measures” like flood prone-areas delimitation, legal measures on land use in these areas, early-warning systems, procedures to apply in case of warning to secure people, animals and assets, management of emergencies. The framework should be based on the internationally recognized and rather new concepts like “Living with the Flood”, “Integrated Flood Management” or “Room for River”.





A major change in flood management in Lao PDR comes from the damming of the rivers. The cascade of reservoirs may be a tool for better managing the floods if reasonable free capacity is left to buffer potential heavy floods and if water release is timely and properly managed and coordinated according to pre-determined procedures. If these procedures are not in place, heavy flood may not be buffered and/or there is a high risk that water release occurs in an inappropriate period putting at risks people and animal's lives as well as assets. Dams and reservoir may be therefore either a potential key tool for flood risks management or a potential key threat making flood even worst or causing unexpected rapid and artificial raising of water level at unappropriated periods.

A batch of security rules for dams and reservoirs management must become part of the package of measures addressing Integrated Flood Management. More specifically, reservoirs operators are concerned by the following measures: (i) keeping enough capacity in the reservoir to be able to buffer an unexpected flash flood; (ii) determine rules in such a way that water release is securely manage to avoid downstream risks; (iii) playing a key role for promoting conservation of water and soil upstream of the reservoirs; (iv) being part of the emergency disposal by implementing early warning measures and support the authorities for managing disasters.

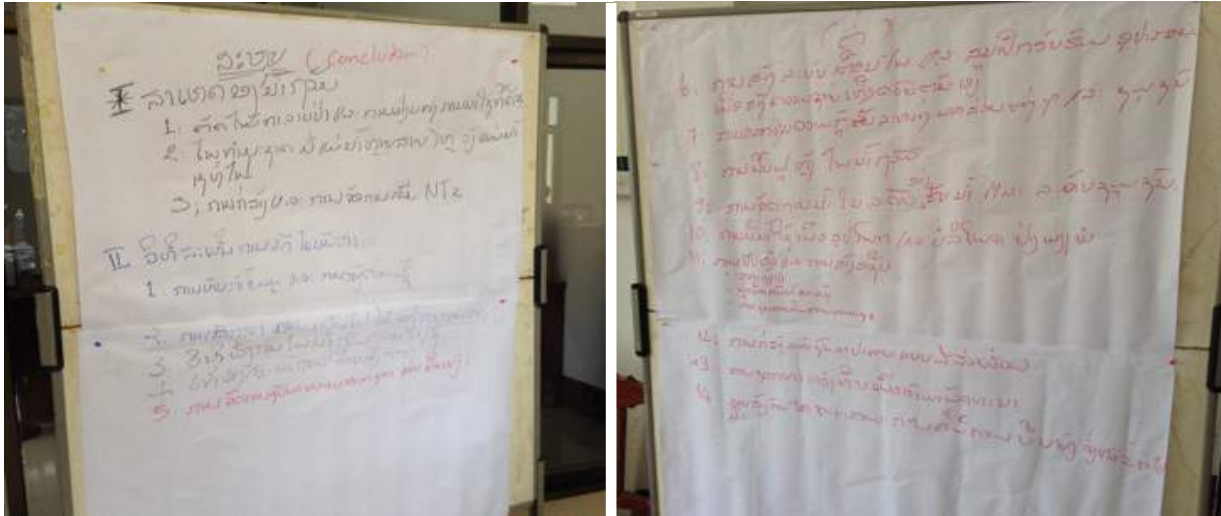
Managing free capacity and secure release to participate to flood risk management is a technically complex task for decision-makers (for both authorities and operators), especially when there is a cascade of reservoirs. It is why modelling may be an essential tool for this purpose. The development of such model (HEC-RESSim) has been recently carried out in Lao PDR (WB support), and a first application in Nam Ngum river basin has been calibrated. This was presented during a former training module on "Collaborative Modelling". It is now very challenging to transform this "theoretical" exercise into a "Collaborative" tool that could bring both Lao PDR Authorities in charge of flood risks management and Dams & Reservoirs operators in order to find a common approach for flood risks management procedures and develop eventually a legal framework that would contribute mitigating this risk.

According to what has been developed above, the training module on "Flood Risks Management" should cover mainly the following approaches for managing floods:

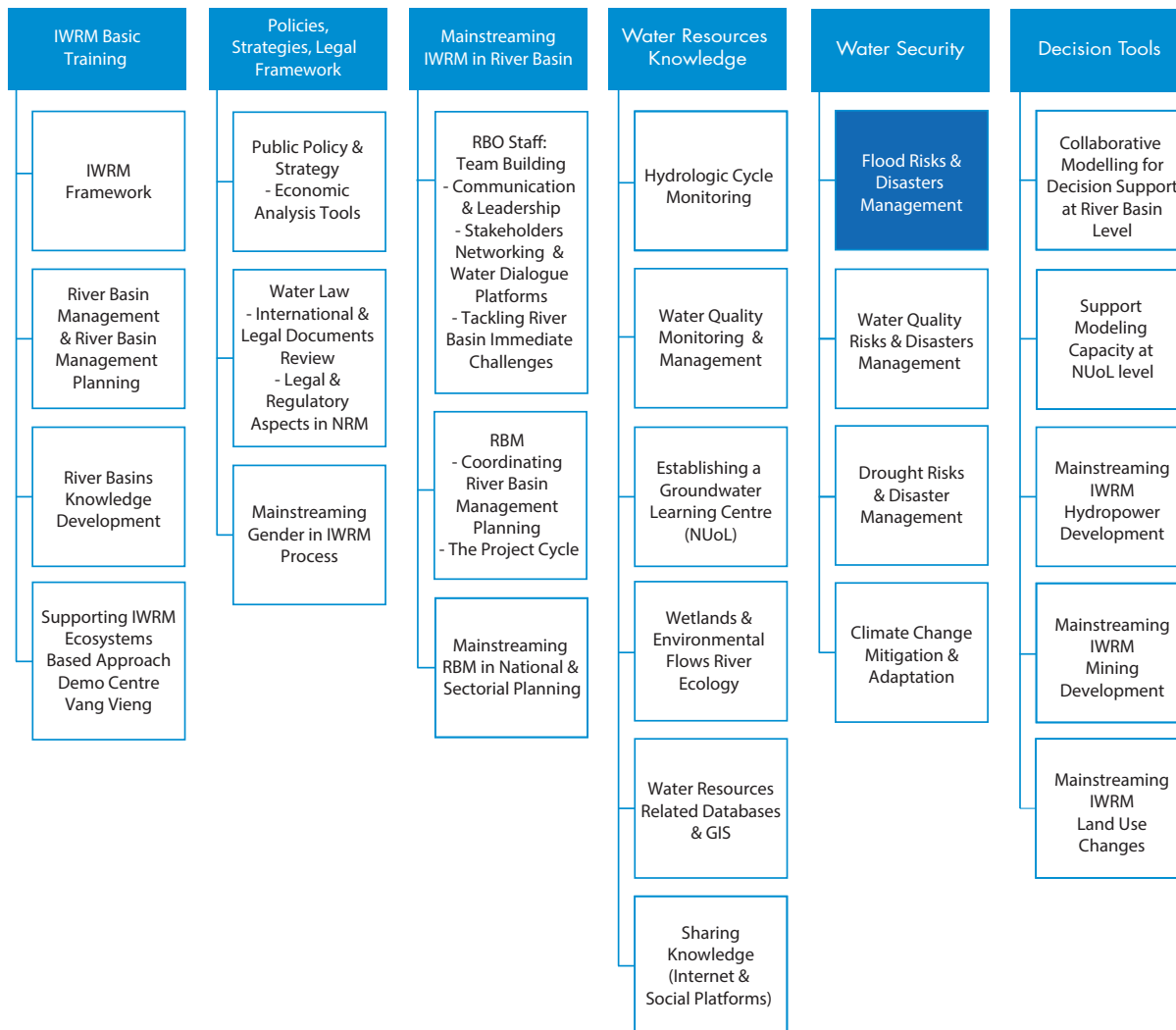
- Infrastructures and "hardware" for flood mitigation (e.g. embankments, dredging, curves rectification): list the possible way of managing flood by such "hardware" measures and present in which situation it may be used, the potential risks and negative impacts, and in which situation it should not or less be implemented.
- "Live with the flood" strategy: list soft measures (e.g. delimitation of flood prone areas, why and how to regulate land-use in such areas ("room for the river"), early warning systems and security procedures, emergency procedure, protection of upper-watersheds. As part of these aspects, the concept of Community-Based integrated flood management must be developed together with the appropriate Governmental support (National, Province, Districts, Kum Ban) for developing and contributing to implement this concept.
- Dams and reservoirs operations: Up to what extent good management of dams may help reducing flood risk or may contribute to exacerbate them; What are the parameters to be taken into consideration (security capacity, water release rules, management of the upper catchments); How "collaborative modelling" may support the management in terms of legal framework and on the spot decision-making; What would be the perspective for a next step in making this model actually operational and how would it fit with the institutional framework (River Basin Committees).
- Eventually, it is essential in this module to explain the process for drafting a Flood Risks Management Plan that will integrate a mix of these different approaches that must be thoroughly selected timely and spatially, in order to maximize the benefits. Such a plan must be drafted in collaboration with the stakeholders and a spatial mapping must indicate where the different measures will be applied, a timeframe for implementation and resources to be mobilized.

Figure 13 allows to localize this module within the framework of the Training Plan:

**Figure 12: Xaybangfai Flood Risk Management Key Action Plan**



**Figure 13: Training Plan Organization Chart**



## B. Expected Outputs

The output of this training module is:

- The trainees have basic knowledge and capacities for understanding the concepts of Flood Risks Management and the major batch of options for tackling this issue: ((i) “Hardware” measures, (ii) “Live with Flood” (“Soft”) measures and (iii) Role of dam operations in flood risk management.
- They get a capacity of analysis to evaluate in which case some measures must be applied and in which case some measures may be potentially counter-productive.
- The trainees understand the basic principles on how to develop a flood risks management plan, with right decisions at the right places, and the process to develop such plan.

## C. Main Topics Covered

The Modeling module would be composed of four sections:

### 1. Managing flood risks by structural works

- Different infrastructures and civil works that may help reducing flood
- In which conditions and situations such measures should be applied
- What may be the negative impacts of such infrastructures and civil works and how far they may become in-operant in the long term
- Elements of Cost-benefit analysis

### 2. Managing flood risks by soft integrated measures

- Different measures that must be developed to mitigate flood risks without jeopardizing flood opportunities like fisheries and agriculture
- Develop the concept of Community-based integrated flood management and support to be provided by the authorities
- Evaluate the needs in terms of institutional and legal framework for implementing soft measures (early warning, crisis management, civil protection, etc.)
- Elements of cost-benefits analysis

### 3. The role of dams and cascade of dams operation in flood management

- Develop the concept of flood hydrogramme and show the different parameters that impact the hydrogramme and more particularly the role of reservoirs.
- In this framework, show how models like HEC-RESSim may help to forecast this hydrogramme and what are the parameters that must be controlled for mitigate the peaks in the hydrogramme
- In this framework, develop the concept of collaborative models for supporting water dialogue between institutions and dam operators and building procedures and legal framework addressing dam safety management for flood control.

### 4. How to develop a flood risk management plan

- Based on a case-study, develop with the trainees a batch of measures that could be ideally developed. Objectives, expected outputs, SWOT analysis and assumptions must be part of this exercise as well as spatial implementation.

## D. Methodology

### Section 1: Managing flood risks by structural works

- Presentation the different possible infrastructures and civil works that may help reducing flood, with particular focus on what has been applied up to now in Lao PDR
- Presentation of advantages and negative impacts of such infrastructures and civil works, analysis of their sustainability in the long term as well as elements of Cost-benefit analysis
- Discussion based on a case study: e.g. Vientiane embankment

### Section 2: Managing flood risks by soft integrated measures

- Presentation of different “soft” measures that may help reducing flood, with particular focus on what was applied up to now in Lao PDR
- Presentation of the concept of Community-based integrated flood management and support to be provided by the authorities
- Presentation of strengths and weaknesses of such “soft” measures and analysis of their sustainability in the long term as well as elements of Cost-benefit analysis
- Case study: e.g. Early warning system in Xebangfai

### Section 3: The role of operation of dams and cascade of dams in flood management

- General presentation of the impact of reservoirs and cascade of reservoirs either to mitigate flood or to contribute to flood risks: explanations based on hydrology and hydraulic theories and illustration based on a case-study
- Presentation of the model HEC-RESSim and utilization of such model for helping the authorities and operators to elaborate rules and procedures that may contribute to manage flood without jeopardizing the benefits from electricity production in case of standalone reservoir and cascade of dams.
- Discussion base on a case study: e.g. Nam Ngum

### Section 4: How to develop a flood risk management plan

- This section would have the form a groups exercise in which each group would have to develop a flood risk management plan.

## E. Modules

Modules	Brief Content	Program	Resource Person
<b>Section 1: Managing flood risks by structural works</b>			
<b>Module 1</b>	Presentation of the different possible infrastructures and civil works that may help reducing flood, with particular focus on what has been applied up to now in Lao PDR	Formal presentation and questions	
<b>Module 2</b>	Presentation of advantages and negative impacts of such infrastructures and civil works and analysis of their sustainability in the long term as well as elements of cost-benefit analysis	Formal presentation and interactive discussion	
<b>Module 3</b>	Discussion based on a case study: e.g. Vientiane embankment	Working group	
<b>Section 2: Managing flood risks by soft integrated measures</b>			
<b>Module 4</b>	Presentation of different “soft” measures that may help reducing flood, with particular focus on what has been applied up to now in Lao PDR	Formal presentation and questions	ICHARM
<b>Module 5</b>	Presentation of the concept of community-based integrated flood management and support to be provided by the authorities	Formal presentation and interactive discussion	ICHARM
<b>Module 6</b>	Presentation of strengths and weaknesses of such “soft” measures and analysis of their sustainability in the long term as well as elements of cost-benefit analysis	Formal presentation and interactive discussion	ICHARM
<b>Module 7</b>	Discussion based on a case study: e.g. Vientiane embankment	Working group	ICHARM



Modules	Brief Content	Program	Resource Person
<b>Section 3: The role of dams and cascade of dams operation in flood management</b>			
<b>Module 8</b>	General presentation of the impact of reservoirs and cascade of reservoirs either to mitigate flood or to contribute to flood risks: theory base on hydrology and hydraulic developments and illustration based on a case-study	Formal presentation and questions	IWRM Training Specialist
<b>Module 9</b>	Presentation of the model HEC-RESSim and utilization of such model for helping the authorities and operators to elaborate rules and procedures that may contribute to manage flood without jeopardizing the benefits from electricity production in case of standalone reservoir and cascade of dams.	Formal presentation and questions	Modeller team IWRM team
<b>Module 10</b>	Discussion based on a case study: e.g. Vientiane embankment	Working groups	Modeller Team IWRM Team
<b>Section 4: How to develop a flood risk management plan</b>			
<b>Module 11</b>	Apply the outputs of the 3 other sections to build an integrated flood risk management plan based on a real case in Lao PDR	Group exercise	ICHARM Modeller team IWRM team
<b>Module 12</b>	Presentation of the results from the group exercise, comparison and discussion. Vote for the best plan.	Group exercise	ICHARM Modeller team IWRM team

## F. Target Components/Focal Points

The institutions that have responsibilities in “Flood Management”, namely:

- MONRE, and related Provincial and District subsidiaries
- NNRBC (and other existing or planned RBC)

## G. Time Frame

Day 1: M1, M2, M3

Day 2: M4, M5, M6, M7

Day 3: M8, M9, M10

Day 4: M11, M12

## H. Resources

A possible resource for managing this training module would be ICHARM (Japan, supported by UNESCO). The mission of ICHARM is to serve as the Global Centre of Excellence for Water Hazard and Risk Management by, inter alia, observing and analyzing natural and social phenomena, developing methodologies and tools, building capacities, creating knowledge networks, and disseminating lessons and information in order to help governments and all stakeholders manage risks of water-related hazards at global, national, and community levels (<http://www.icharm.pwri.go.jp>).

## III. Training Program Agenda

### Day 1

Time	Program	Resource Person
8:00-8:30	Registration	DWR
8:30-9:00	Opening ceremony	Xaybangfai PONRE
9:00-9:30	Presentation purpose of the workshop	DWR, Training Director
<b>Session 1: Introduction of Water Security, Flood and Drought Concepts, Physical Characteristics, Risks and Opportunities</b> <b>Objectives:</b> <ul style="list-style-type: none"> <li>To build basic understanding in flood risk characteristics, historical data and impacts</li> </ul> <b>Methodology:</b> <ul style="list-style-type: none"> <li>Keynote presentation and discussion</li> </ul>		
9:30-10:15	Introduction: basic concept of water security: flood and drought characteristic, risks and opportunities Plenary discussion <i>Keynote presentation 1 (Lao), 2 (English)</i>	DWR DWR, Senior Technical Officer International IWRM Training Specialist
10:15-10:45	Flood Characteristics in Xaybangfai Basin, before and after NT2 Hydropower <i>Keynote presentation 3 (English)</i>	NTPC Company
10:45-11:00	Break	
11:00-11:30	Flood historical data, modeling and flood study of Xaybangfai Basin <i>Keynote presentation 4, 5 (English)</i>	Rachamangkhal Technology of Isan, Thailand and NREI
11:30-12:00	Plenary discussion	Director, PONRE Khammone/ Director of Training and Awareness Center
12:00-13:30	Lunch	

Time	Program	Resource Person
<b>Session 2: The Role of Dams and Cascade of Dams Operation in Flood/Drought Management</b> <b>Objectives:</b> <ul style="list-style-type: none"> <li>To better understand purposes, operational process, roles, benefits and impacts of Hydropower and Nam Thuan 2 Hydropower</li> </ul> <b>Methodology:</b> <ul style="list-style-type: none"> <li>Presentations and discussions</li> </ul>		
13:30-14:45	Impacts (positive and negative) of reservoirs and cascade on floods and water shortage  Discussion	NUOL
14:45-15:30	Hydropower optimization model, Xeybangfi and Nam Thun Basin  Discussion  <i>Document 1: NT2 Environmental Monitoring Report</i>	NTPC
15:30-15:45	Break	
15:45-16:15	Plenary discussion	DWR, Training Director
16:15-16:30	Closing	PONRE Khammouane



## Day 2

Time	Program	Resource Person
<b>Session 3: Flood and Drought Impacts/Opportunity and Existing Mitigation Plans</b> <b>Objectives:</b> <ul style="list-style-type: none"> <li>To dialogue and further understand the associated risks and benefits of natural and man-made floods, and potential mitigation measures at basin and local scales</li> </ul> <b>Methodology:</b> <ul style="list-style-type: none"> <li>Keynote, focus group and plenary discussion</li> </ul>		
08:30-09:00	Recap	Trainees
09:00-10:00	Flood/drought impacts and opportunities: by Head of the village Bann Burapa district, Xaybangfai upstream Bann Yommaraj district, Xaybangfai, mid-stream Bann Yang Kham, Xaybangfai district, lower mid-stream Bann Nong Bok district, downstream	Xaybangfai Basin Head of villages
10:00-10:45	On-going mitigation plans Discussion	NTPC
10:45-11:00	Break	
11:00-11:30	Existing flood and drought mitigation initiative	WB-MIWRM, Flood Management Technical Officer
11:30-12:00	Plenary discussion	DWR and PONRE Khammouane
12:00-13:30	Lunch	
<b>Session 4: Managing Flood Risks by Structural Works</b> <b>Objectives:</b> <ul style="list-style-type: none"> <li>To review and discuss on possible structural flood mitigation approach</li> </ul> <b>Methodology:</b> <ul style="list-style-type: none"> <li>Keynote presentations, and discussions</li> </ul>		
13:30-14:15	Different types of infrastructure and civil work (lessons learnt) that mitigate floods, applied in Lao PDR Plenary discussion	Ministry of Public Work and Transportation
14:15-15:00	Flood forecast and early warning system infrastructure in Xaybangfai Discussion	DMH, WB-MIWRM, Meteorology Component
15:00-15:15	Coffee Break	



Time	Program	Resource Person
15:15-15:45	SWOT and Sustainability Analysis of applied flood mitigation infrastructure in Xaybangfai	Department of Irrigation
15:45-16:15	Experiences from locals	Villages in Xaybangfai Heads of Villages
16:15-16:30	Closing	Khammouane provincial

## Day 3

Time	Program	Resource Person
<b>Session 5: Managing flood (and drought) risks by soft integrated measures</b> <b>Objectives:</b> <ul style="list-style-type: none"> <li>To review and discuss on possible non-structural flood mitigation approach</li> </ul> <b>Methodology:</b> <ul style="list-style-type: none"> <li>Keynote presentations, and discussions</li> </ul>		
8:30-9:00	Recap	Trainees
9:00-9:30	Different soft-measures/approaches on flood mitigation applied in Lao PDR	DWR, WB-MIWRM
9:30-10:00	Fisheries mitigation <i>Document 2 : NT2 Fisheries Study</i>	NTPC
10:00-10:30	Proposed concept of community based integrated flood/ flow monitoring and support <i>Keynote presentation 6 (English)</i>	The Asia Foundation
10:30-10:45	Break	
10:45-12:00	Small Group Discussion on Action Plan and Flood Mitigation Process	CTA
12:00-13:30	Lunch	
13:30-15:00	Small Group Discussion on Action Plan and Flood Mitigation Process	Trainee groups
15:00-15:15	Break	
15:15-16:00	Report back to plenary	Trainee Groups, CTA
16:00-16:30	Engagement building, wrap-up and closing	Khammouane Province/ DW

## Day 4

Time	Program	Resource Person
<b>Session 6: Field Visits, 3 Xaybangfai Villages</b> <b>Objectives:</b> <ul style="list-style-type: none"><li>To Site survey for local research, collecting data</li></ul> <b>Methodology:</b> <ul style="list-style-type: none"><li>Field Observation, stakeholder interviews</li></ul>		
Village 1: Xaybangfai District, lower mid-stream Village 2: Nongbok District, downstream Village 3: Burapha District, upstream		
12:00-13:30	Lunch	
13:30	Travel back to Vientiane	







# IV. Training Materials

## Keynote presentation 1: Basic Concept of Floods (Lao)



ຫົວຂໍ້ທີ່ນຳສະເໜີໃນນີ້ນີ້

- 1. ນິຍາມ ແລະ ຄວາມໝາຍ
- 2. ປະເພດນ້ຳຖ້ວມ (Flash Flood)
- 3. ຜົນກະທົບຈາກໄພນ້ຳຖ້ວມ (impacts of flood)
- 4. ການປ້ອງກັນ ແລະ ຫຼຸດຜ່ອນໄພນ້ຳຖ້ວມ


1. ນິຍາມ ແລະ ຄວາມໝາຍ

☐ ໄພພິບັດແມ່ນຫຍັງ


ແມ່ນສິ່ງທີ່ເປັນອັນຕະລາຍຕໍ່ຊີວິດ ແລະ ຊັບສິນອັນມີຄ່າຂອງມະນຸດເຮົາ ກໍ່ຄື ຊັບພະຍາກອນທຳມະຊາດ ຊຶ່ງເຫດການດັ່ງກ່າວນີ້ ທາງພໍ່ແມ່ ປະຊາຊົນ ກໍ່ຄືປະຊາຊົນທີ່ວປະເທດ ຍາມໃດກໍ່ບໍ່ຢາກຖະໜາບໍ່ຢາກພົບພໍ້ ບັນຫາດັ່ງກ່າວນີ້



# Flood Risks Management

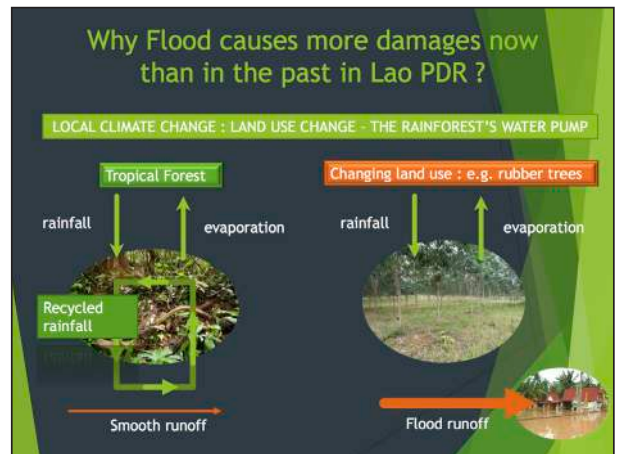


NIWRMSP Building Capacity:  
Package 1

 Eric Tilman  
International Consultant  
[www.riversnetwork.org](http://www.riversnetwork.org)

### Flood risk management is part of « Water Security »...

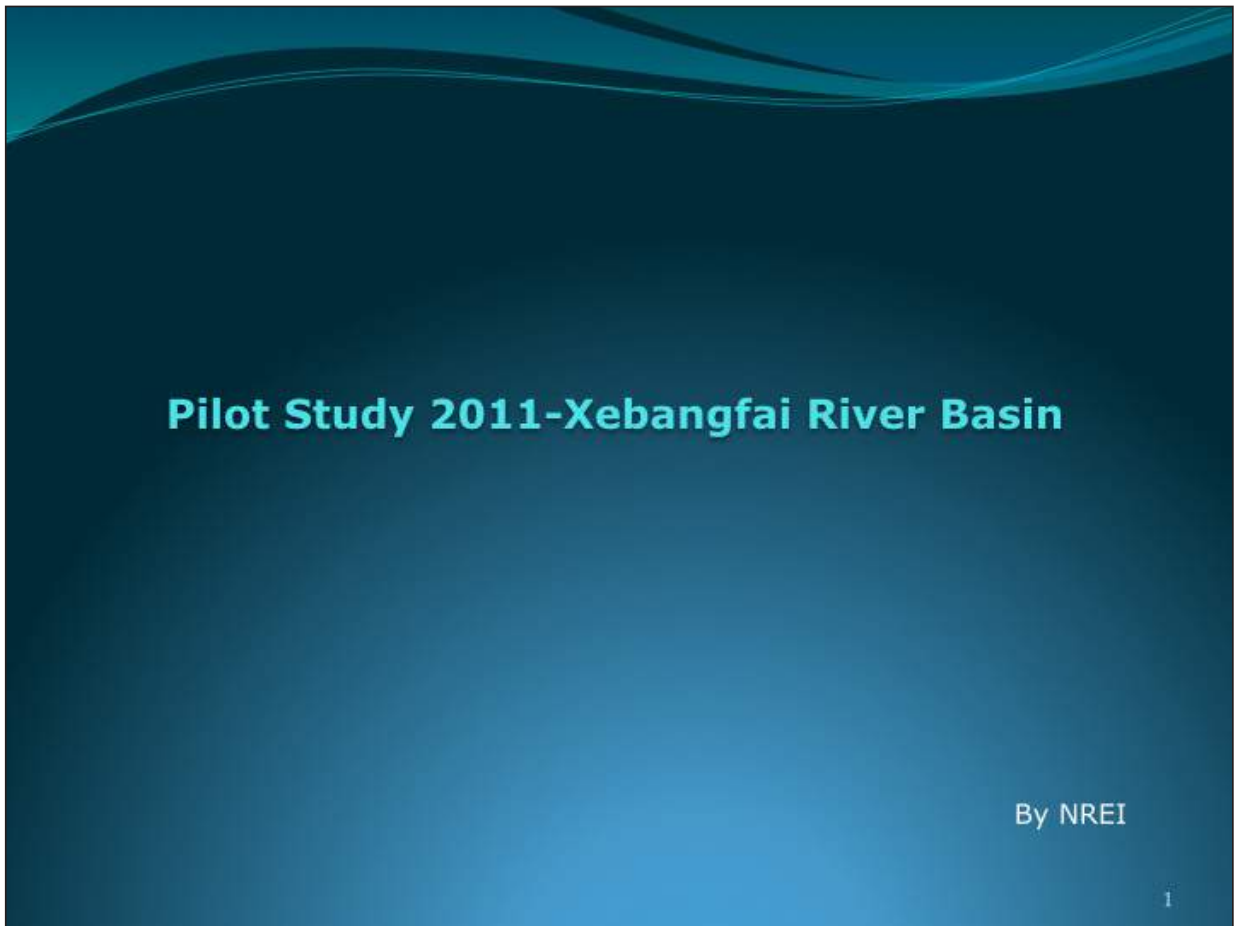
 <b>To Much Water...</b> <ul style="list-style-type: none"><li>• Floods Risks</li></ul>	 <b>Not Enough Water...</b> <ul style="list-style-type: none"><li>• Drought Risks</li></ul>	 <b>Bad Water Quality</b> <ul style="list-style-type: none"><li>• Health and Environment Risks</li></ul>
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## Keynote presentation 3: NT2 Hydropower Management (English)



## Keynote presentation 4: Flood risks pilot study in Xaybangfai (English)



**Figure 15: Xay Bangfai River Basin**



- › One of the river basins of the Mekong River
- › Basin area: 9,871 km<sup>2</sup>
- › River length: 370 km
- › Average discharge: 315 m<sup>3</sup>/s
- › Average annual rainfall: 1,400 - 2,600 mm
- › Average air temperature: 21-32°C
- › Basin population: 254,664 (2008)



## Keynote presentation 5: Xaybangfai Flood's Model (English)

Cambodia • Lao PDR • Thailand • Viet Nam  
For sustainable development



**HEC-RAS Model :**  
Collaborative Modeling Training and stakeholder engagement in Xebangfai.  
กรณีศึกษา : ลุ่มน้ำสาขา Xebangfai River




**Assistant Professor Rachaphat Ratanavaraha**  
DIRECTOR OF WATER RESOURCES MANAGEMENT RESEARCH CENTER:  
KONG - CHI - MUN RIVER BASIN :  
TNMC :Thailand : CCAI : IKMP : BDP : EP :FP: MRC  
Rajamangala University of Technology Isan - RMUTI

[www.mrcmekong.org](http://www.mrcmekong.org)

### Nam Theun 2

The Nam Theun 2 Hydropower Project, or simply NT2, is a [hydroelectric dam](#) located on the [Nam Theun River](#) in [Laos](#). Commercial operation of the plant began in March 2010. The scheme diverts water from the Nam Theun, a [tributary](#) of the [Mekong River](#), to the [XeBang Fai River](#), enabling a generation capacity of 1,070 [MW](#), from a 350 m (1,148 ft) difference in elevation between the [reservoir](#) and the [power station](#).




[www.mrcmekong.org](http://www.mrcmekong.org)

### The Project....

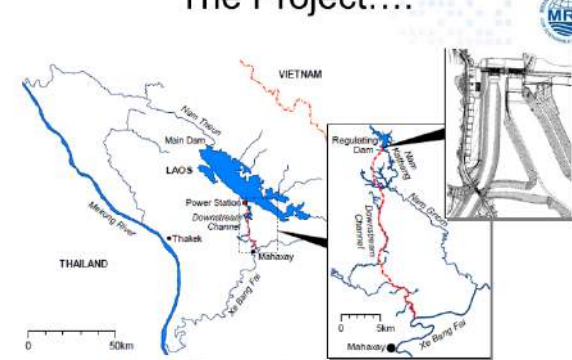
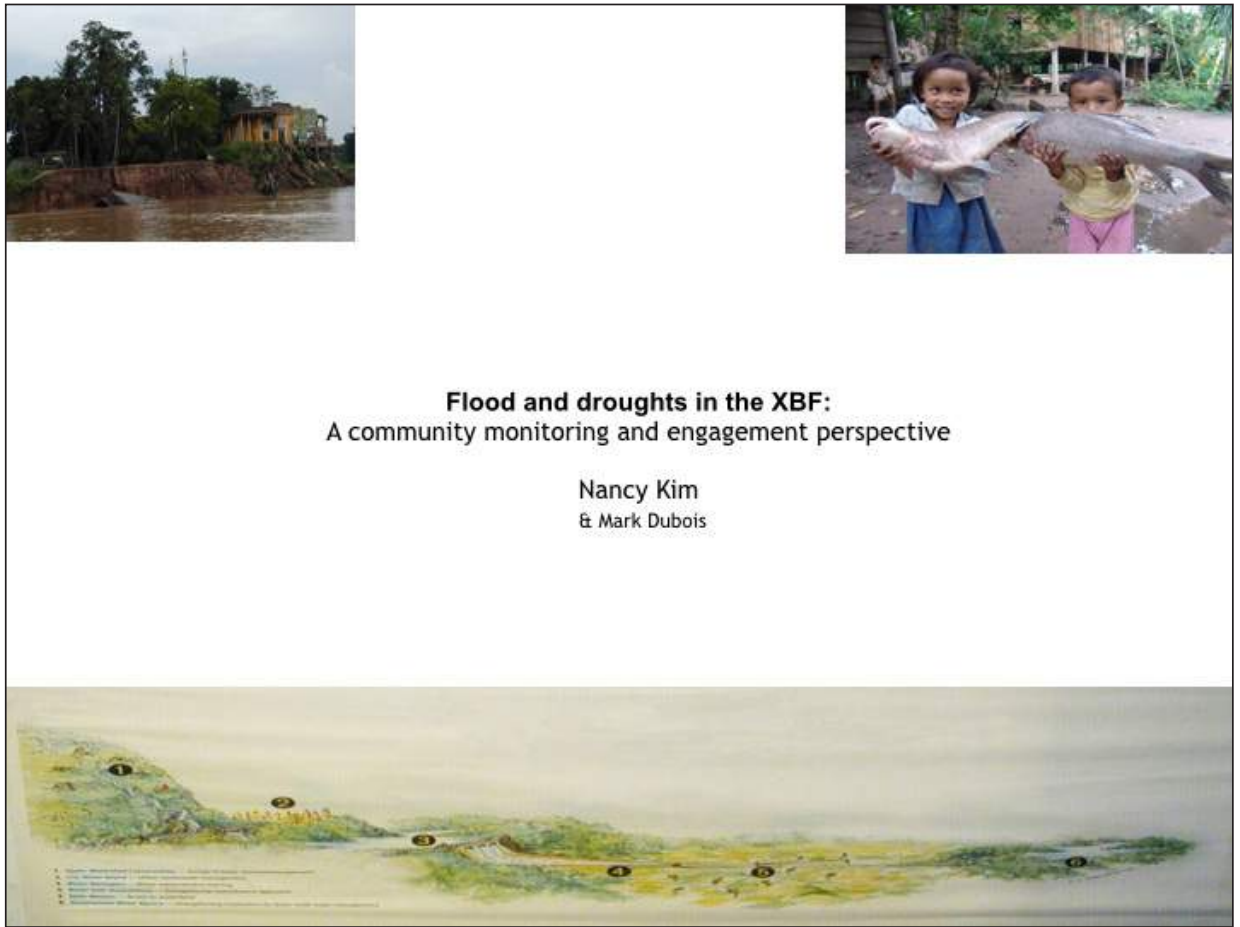


Figure 1 – Nam Theun 2 Locality Plan

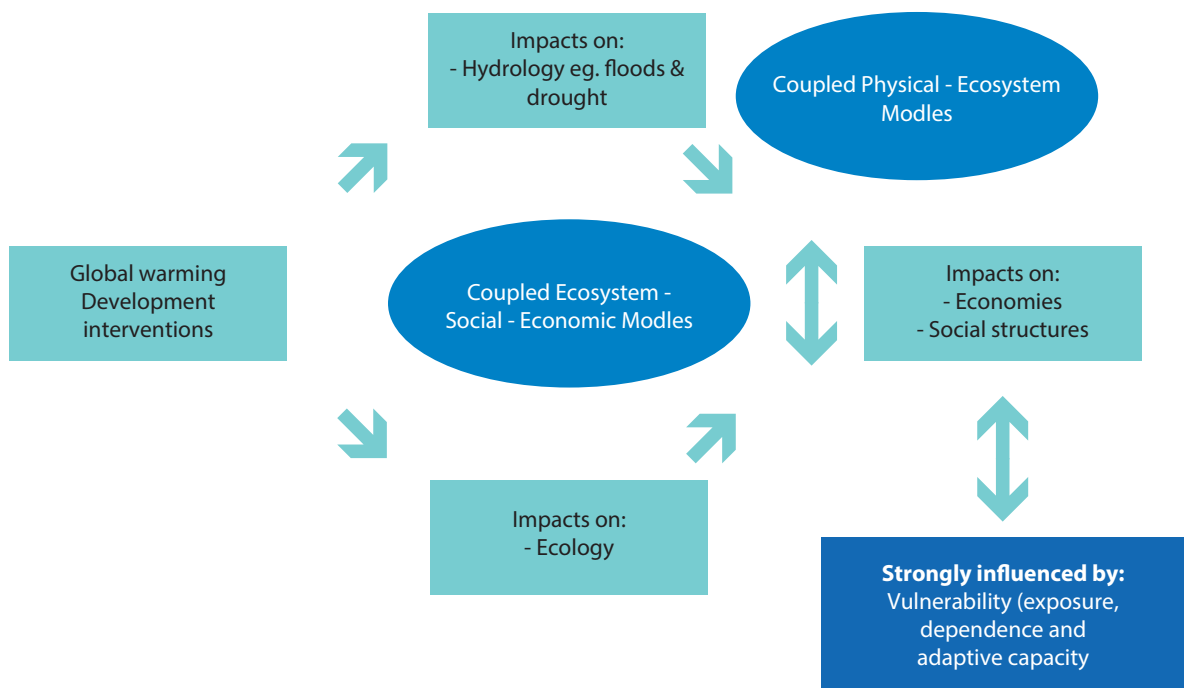
[www.mrcmekong.org](http://www.mrcmekong.org)



## Keynote presentation 6: Floods in local perspectives (English)



**Figure 16: Flood and droughts in the XBF**



# Document 1: NT2 Environmental Monitoring Report

Hydroécol. Appl.  
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DOI: 10.1051/hydro/20141005

<http://www.hydroecologie.org>

## Main features of the Nam Theun 2 hydroelectric project (Lao PDR) and the associated environmental monitoring programmes

### Principales caractéristiques de l'aménagement hydroélectrique de Nam Theun 2 (Laos) et programmes de suivi environnementaux

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- (2) Nam Theun 2 Power Company Limited (NTPC), Environment & Social Division – Water Quality and Biodiversity Dept. – Gnommalath Office, PO Box 5862, Vientiane, Lao PDR
- (3) NTPC – Operation & Maintenance Division – Operation Dept. – Gnommalath Office, PO Box 5862, Vientiane, Lao PDR
- (4) NTPC – Environment & Social Division – Gnommalath Office, PO Box 5862, Vientiane, Lao PDR

**Abstract** – The Nam Theun 2 hydroelectric Project is located in Lao PDR on the Nam Theun River. The reservoir impoundment started in April 2008 and hydropower generation began in March 2010. The reservoir has a total volume of 3.9 billion m<sup>3</sup>, covering an area of 489 km<sup>2</sup> at full supply level and 86 km<sup>2</sup> at the minimum operating level. The performance is 1070 MW and the annual production is 6 TWh. The reservoir is operated seasonally by storing water during the wet season. A system of tunnels and channels diverts the waters from the Nam Theun watershed to the Xe Bangfai watershed. An ambitious environmental monitoring programme of project sites was launched by EDF – NTPC in 2008 and remains operational. An on-site laboratory was established to ensure sampling and analysis in real time. The compartments studied are water quality, greenhouse gas emissions, phytoplankton, zooplankton, benthic macroinvertebrates and fish. A 3D numerical model was developed based on monitoring data to predict the long-term changes in water quality and greenhouse gas production of the reservoir. Additional research programmes have been launched to understand bio-chemical dynamics and processes.

**Key words** – Nam Theun 2, dam, sub-tropical reservoir, impoundment, environmental monitoring

**Résumé** – Le projet hydroélectrique de Nam Theun 2 se situe au Laos sur la rivière Nam Theun. Le réservoir a été mis en eau en avril 2008 et la production hydroélectrique a commencé en mars 2010. Il couvre une superficie totale de 489 km<sup>2</sup> à la cote maximale et 86 km<sup>2</sup>

Article publié par EDP Sciences

à la cote minimale d'exploitation. Le volume total du réservoir est de 3,9 milliard de m<sup>3</sup>. La puissance totale est de 1070 MW pour un productible de 6 TWh. L'aménagement est géré de façon saisonnière en stockant les eaux pendant la saison humide. Il dérive les eaux de la Nam Theun vers le bassin versant de la Xe Bangfai. Un programme ambitieux de suivi des effets sur l'environnement a été conduit par EDF et NTPC dès 2008. Toujours en activité, ce programme a nécessité la mise en place d'un laboratoire sur site pour assurer les prélèvements et analyses en temps réel. Les compartiments étudiés sont la qualité des eaux, les gaz à effet de serre, le phytoplancton et le zooplancton, les macro-invertébrés benthiques et les poissons. Un modèle numérique 3D a également été élaboré à partir des données du suivi afin de prévoir l'évolution du réservoir en termes de qualité des eaux et de production de gaz à effet de serre. Des programmes de recherche complémentaires ont été lancés en parallèle afin d'apporter des éléments de réponses à certains problèmes spécifiques.

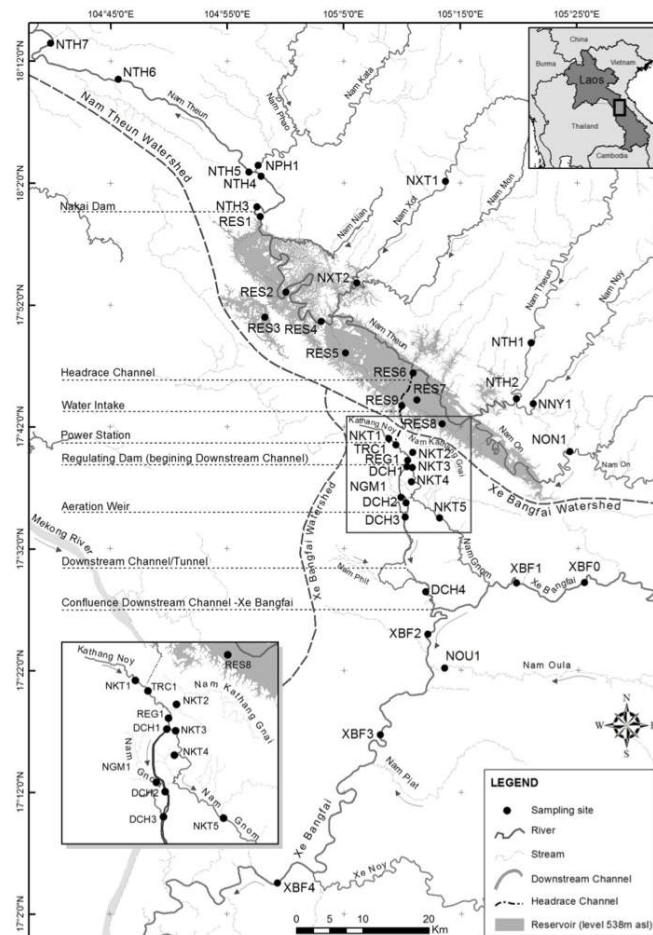
**Mots-clés** – Nam Theun 2, barrage, réservoir sub-tropical, mise en eau, suivi environnemental

## 1 INTRODUCTION

Southeast Asian economies are developing fast and large parts of the growing electricity demand will be sourced by hydropower. The Mekong watershed was identified for numerous hydropower projects. Among the countries surrounding the Mekong basin, the Lao People's Democratic Republic (Lao PDR) harbours a high hydropower potential.

The hydroelectric potential of the Nam Theun River on the Nakai Plateau was for the first time mentioned in 1927. In 1994, the Nam Theun 2 Electricity Consortium (NTEC) was created to plan and design the Nam Theun 2 (NT2) Project. It included a comprehensive environmental and social impact assessment and was supported by the World Bank, the Agence Française de Développement, the Asian Development Bank and the Government of Laos. The NT2 Project is part of the 7000 MW electricity export programme between Laos and Thailand. By 2004, NTEC transferred the development and implementation responsibility to the newly founded Nam Theun 2 Power Company Ltd. (NTPC). NTPC is a shareholder company, owned by Electricité de France International (EDF, 40%), Lao Holding State Enterprise (LHSE, 25%), Electricity Generating Public Company Limited (EGCO, 35%). NT2's construction works began in 2005 consecutive to the finalization of the Concession Agreement (CA). The construction was completed in March 2010 and commercial operation began in April 2010.

The CA defines environmental and social obligations, some of which last throughout the concession period. The implementation of the environmental and social programmes is monitored by various external agencies including the technical advisors of the lending agencies, the Laoian Government through the Panel of Experts and Independent Monitoring Agencies, independent consultants and multilateral development



## Document 2: NT2 Fisheries Study

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http://www.hydroecologie.org

### Developing approaches for establishing a fisheries baseline: case-study for Xe Bangfai basin (Lao PDR)

*Développement d'approches pour l'établissement d'une référence des pêches : le cas d'étude de la Xe Bangfai (Laos)*

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**Abstract** – The approach of Fish Catch Monitoring of the Nam Theun 2 hydro power project area is documented and describes the fish catch monitoring methodologies implemented for the period from 2006-2014 with special emphasis on changes in the methods and how data collection has evolved in the Xe Bangfai basin. The collected data aimed at documenting changes in the fisheries (e.g. habitat use, daily household catch, gear use and effort) before and after commencement of electricity generation. The methods used rely on social research methods, i.e. recall surveys and household catch logbooks that are provided and maintained by fishermen. The panel survey has demonstrated its appropriateness to monitor and document changes in the fisheries over time with a high level of confidence at relatively low cost. The households participating in the panel remained relatively stable throughout the survey period. The method tends to overestimate fish catches and under estimate the collection of other aquatic animals. The level of effort (fishing days) is consistent between different surveys. The monitoring results provide a good understanding of trends and changes in the fisheries.

**Key words** – fisheries, monitoring, river, logbook, evaluation

**Résumé** – L'approche du suivi des pêches au sein du projet hydro-électrique Nam Theun 2 (Laos) est documentée et décrit les méthodes de suivi des pêches mises en place pour la période de 2006-2014 en mettant l'accent sur le changement des méthodes et la façon dont la collecte des données a évolué dans le bassin de la Xe Bangfai. Les données récoltées visaient à documenter les changements observés au niveau des pêches (par exemple l'utilisation de l'habitat, prises quotidiennes des foyers, moyens et effort de pêche) avant et après le début de la production d'électricité. Les méthodes utilisées s'appuient sur des méthodes de recherche sociale, à savoir les enquêtes faisant appel à la mémoire et les registres quotidiens des prises des foyers qui sont fournis et entretenus par les pêcheurs. Cette enquête par panel a démontré sa pertinence pour suivre et documenter les changements observés au niveau de pêches au fil du temps, ceci avec un niveau de confiance élevé et à un coût relativement faible. Les foyers participants à ce panel sont restés relativement stables sur la

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durée de l'enquête. Les méthodes ont tendance à surestimer les prises de poissons et à sous-estimer les prises des autres animaux aquatiques. Le niveau d'effort fourni (en jours de pêche) est cohérent entre les différentes enquêtes. Les résultats du suivi fournissent une bonne compréhension des tendances et changements des pêches.

**Mots-clés** – pêches, suivi, rivière, registre, évaluation

### 1 INTRODUCTION

Fisheries are a major activity for many people living in inland and coastal areas and are considered to be the major source of protein for rural populations. Information on actual levels of consumption and catch are scant, but research data suggest that for example the inland capture fisheries in the Mekong basin may produce over 3 Million tons (Mt) per annum (Hortle & Bush, 2003). The official catch estimates, where available, do not even come close to this amount and may underestimate the actual fish production with a factor of 2 to 3 times.

Inland fisheries are not a homogeneous collection of fisheries, as there are many different levels of operation, down from collection by hand by family members to almost industrial sized operations (e.g. Dai fisheries in the Tonle Sap, Cambodia). Although a few localized commercial fisheries of middle to large scale can be observed, most of the operations are small one man/household sized operations (often family business or small enterprises) that are scattered in space and time, using a wide array of gears and habitats for catching a wide variety of species.

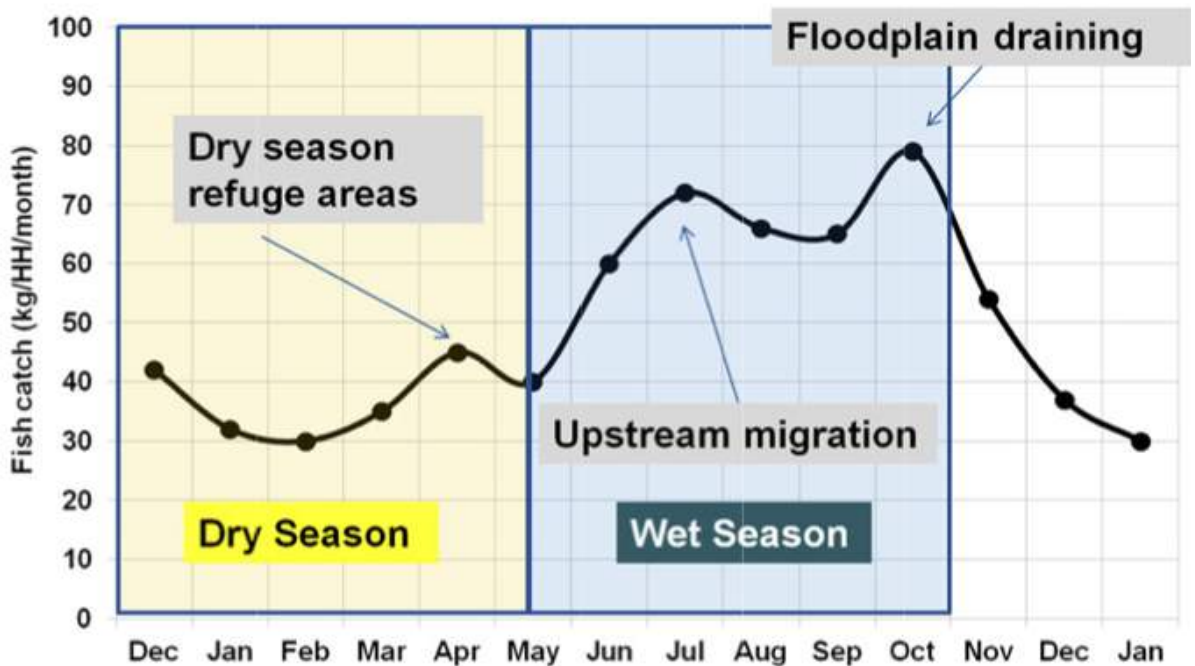
The fishing activities often have a large subsistence component, with many fishers active only for part of the year. Even for commercial fishermen, fishing is often only one of the livelihood

activities. Since most fishing activities tend to occur early in the morning, even a full-time (professional) fisherman may be back home before 10 in the morning, with earnings from that day's catch. This leaves enough time for other activities and indeed it is rare for fishing to be the only source of income. However, for most households, fishing is a subsistence activity and a source of incidental income when more is caught than the household needs for consumption.

Reservoir, river and floodplain fisheries are all characterised by fixed fishing grounds, seasonal differences in catches (Fig. 1) and species composition, with both formal and informal landing sites and fish trade systems. Fisheries have a close relationship with their environment and are therefore the prime focus of recent participatory management approaches.

Due to the inherent dynamics of inland waters, the heavy dependence on floodplains in river fisheries, either directly (floodplain fisheries) or indirectly (much of the catches, i.e. biological production, in rivers and reservoirs is actually produced on the floodplains), there may be huge fluctuations in production from one year to another, that are largely unrelated to the fishing pressure. It has been widely acknowledged that floodplains are the engine that drives riverine fisheries (flood pulse concept; Junk et al., 1989), and

### Developing approaches for establishing a fisheries baseline: case-study for Xe Bangfai basin (Lao PDR)



# **Training Manual for Project Cycle Management**





# I. Fact Sheet

Name of training course:	<b>Project Cycle Management</b>
Level and specialty:	Medium level and on-the-job based training
After the training, the trainees will:	<ol style="list-style-type: none"><li>1. Understand the concepts of result-chain and project cycle management (PCM);</li><li>2. Can design and plan projects using Logical Framework Analysis (LFA) convention;</li><li>3. Know basic concepts and steps involved in project monitoring and evaluation.</li></ol>
Target groups:	<p>This training was specifically designed for target trainees from ADB TA7780 and WB-MIWRM project and activity managers and technical staff from MONRE. The trainees include:</p> <ul style="list-style-type: none"><li>• Department of Water Resources</li><li>• Nam Ngum River Basin Committee Secretariat</li><li>• National Research Institute</li><li>• National University of Laos</li><li>• Local communities and impacted groups</li></ul>
Number of training days:	3 days
Dates and venue of training:	This training was already conducted in Vientiane Capital
Number of trainees:	41 Trainees (12 women and 39 men)
List of trainees:	See Annex A-6
List of principal trainers:	Mr. Driravadh Tan
Training methodologies:	<p>The training was divided into six different sessions which exploited different methodologies that include</p> <ul style="list-style-type: none"><li>• Keynote presentations and interactive discussions prepared and facilitated by trainers</li><li>• Group exercises</li></ul>
Training materials:	<ol style="list-style-type: none"><li>1. Situation Analysis, Training Concept and Training Modules</li><li>2. Training Program Agenda with Training Methodologies</li><li>3. Keynote Presentations</li></ol>

Recommended additional reference materials:

N/A

Training assessment results and findings:

**Project Cycle Management Training** was conducted on July 21-25 in Vientiane Capital. There were 41 trainees attended.

The training was rated by **8.5 out of 10**. All the objectives were successfully achieved. The feedbacks provided by the trainees suggested that the training was very pragmatic and gave very relax and friendly atmosphere. Towards the end of the training, the trainees requested to extend this type of training to other groups and levels that may be interested. During the training, it was observed that there were discrepancy among the trainees in the usage and understanding of key logical framework analysis terms such as program, project, goal, objective, outcome, output, indicator and assumption. But after the training, the participants' understanding of these terms appeared to be unified in which suggested the training had improved the participants' understanding of project cycle management and how to manage their projects at each stage of the project cycle. They should be also able to apply logical framework analysis to their works in river basin management after this training in the future.

Summary of key achievements

- The trainees have a sound understanding of PCM and how to manage their projects at each stage of the process. They should be able to apply LFA to their works in river basin management.
- The participants share a common set of PCM/LFA terminology in both Lao and English that is ready to apply to RBM project design and formulation;
- The participants are able to use the design tools such as LFA in formulating their projects along with other tools such as Stakeholder Analysis;
- The participants are familiar with the planning and implementation procedures such as activity breakdown, Gantt chart, resource and budget allocation.

And due to time constraint, the following objectives were partially achieved and more training is recommended:

- The participants can plan their projects and determine the critical path of the PERT network (for activity delay or time constraint);
- The participants understand the significance of monitoring and evaluation procedure and progress reporting routine;
- The participants know the administrative and finance tools for procurement and contracting procedures, budget control, accounting and auditing

Next steps and Recommendations:

1. Follow up training. Training of Trainer Course in PCM should be considered.
2. Capacity building or training in Report and Proposal Writing should be considered.

## II. Situation Analysis, Training Concepts and Training Modules

### A. Justification

Managing River Basins and Watersheds is one of the IWRM areas. River basin management (RBM) may be defined as the process of coordinating conservation, management and development of water, land and related resources across sectors within a given river basin, in order to maximize the economic and social benefits derived from water resources in an equitable manner while preserving and, where necessary, restoring freshwater ecosystems.

Conducting RBM is generally understood as a spiral process; each cycle of the spiral comprising several steps. It is expected that the next cycle of the spiral will be better managed than the previous one, after evaluation and lessons learned. The key steps are globally as follows: (i) establishing a river basin profile and mapping the stakeholders; (ii) develop water dialogue amongst the stakeholders for identifying issues and opportunities and developing shared vision; (iii) together with the stakeholders, develop a road map with short, middle and long term strategies; (iv) from the road map, develop actions plans that will be mainstreamed into the socio-economic development plan at different level (national, provincial and district) or that may be part of the legal framework; (v) monitor and evaluate the implementation of the actions plans which will be an entry for updating each of the steps during the next cycle. A cycle may reasonably cover a period of 5 years.

Each level of the spiral is similar to the traditional definition of a "Project Cycle", consisting of steps with clearly specified objectives within a defined time-period and with a defined budget.

Intentionally, we suggest this training to address "Project Cycle Management" in a broader way than just referring to RBMP. This should give the opportunity to the trainees who are involved in the different ADB/WB components to get a better understanding of what is behind "Project Cycle", and for those who are developing RBMP in the framework of their activities, to have a reference tool to implement the step-wise "Spiral".

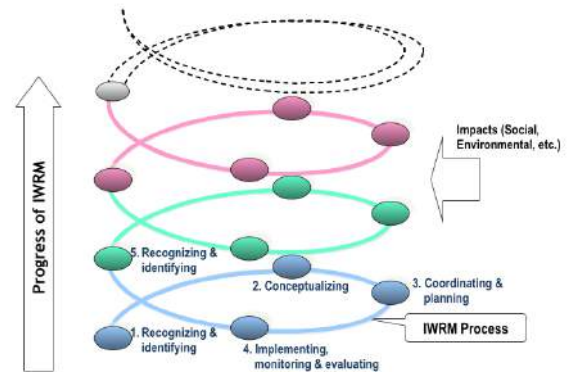


Figure 17: IWRM Spiral & Process

The requirements for the implementation of the "Project Cycle" are:

- Clearly identified stakeholders, including the primary target group and the final beneficiaries; Clearly defined coordination, management and financing arrangements;
- A monitoring and evaluation system (to support performance management); and
- An appropriate level of financial and economic analysis, which indicates that the project's benefits will exceed its costs.

"Project Cycle" purpose and content must be drawn specifically to take into account the National context, such as the legal and institutional framework, the national planning process. In case of external funding, special requirements from the financing agencies may create needs for an additional level of procedures and rules. It is actually the case if we consider the diversity of the intervention in the ADB and WB components. In order to accommodate this kind of diversity, it is important that project cycle management systems support the application of standard working modalities/rules, but in a flexible manner. It is part of the concerns of the PMU when coordinating and monitoring these components.



A critical issue is that the Funding Agencies have their own standard working modalities/rules and that the beneficiary country has its own standard as well. In our case, the PMU has to cope with ADB<sup>11</sup>, WB<sup>12</sup> and Lao rules. These standards are generally specific for administrative and financial procedures whereas technical areas of the projects implementation may be more flexible in their presentation.

The reliable, effectively and timely delivery of the project outputs are very often hindered by inefficient or misunderstanding of the administrative and financial procedures. It is not rare to have an activity technically well prepared, but actually delayed for procedures reasons. It also often happens that, for the same reasons, critical activities are delayed jeopardizing the whole project and its credibility among the beneficiaries.

It is therefore important for Administrative & Finance staff to have a clear understanding of the project planning necessities in such a way that they may optimize the procedures for smooth project implementation. It is also important for the Technical Staff to be aware of the administrative procedures, and particularly the necessary delays, in order to be more pro-active and pragmatic when planning the project activities.

This Training will be addressed to both Technical and Admin staff and will include the most important tools that are used when implementing a project:

- **Design Tools (reference framework):** Logical frame-work, activities, resources and budget
- **Planning and Implementation Tools:** planning charts, identification of resources and budget, managing cash flow and funds replenishment
- **Monitoring Tools:** Monitoring review and reporting process
- **Admin and Finance Tools:** administrative & finance procedures, procurement and contracts awarding, budget control, cash flow management, accounting and auditing

In view to better coordinated the project components, this training will offer as well an opportunity for the mixed teams (Technical and Admin) (i) to carry out a short review and comparison between the ADB, WB and Lao PDR administrative and Financial procedures and (ii) to identify constraints regarding all steps of activities implementation for allowing more pro-active planning and get eventually more reliable and timely delivery of the outputs.

This training module is part of the Training Plan:

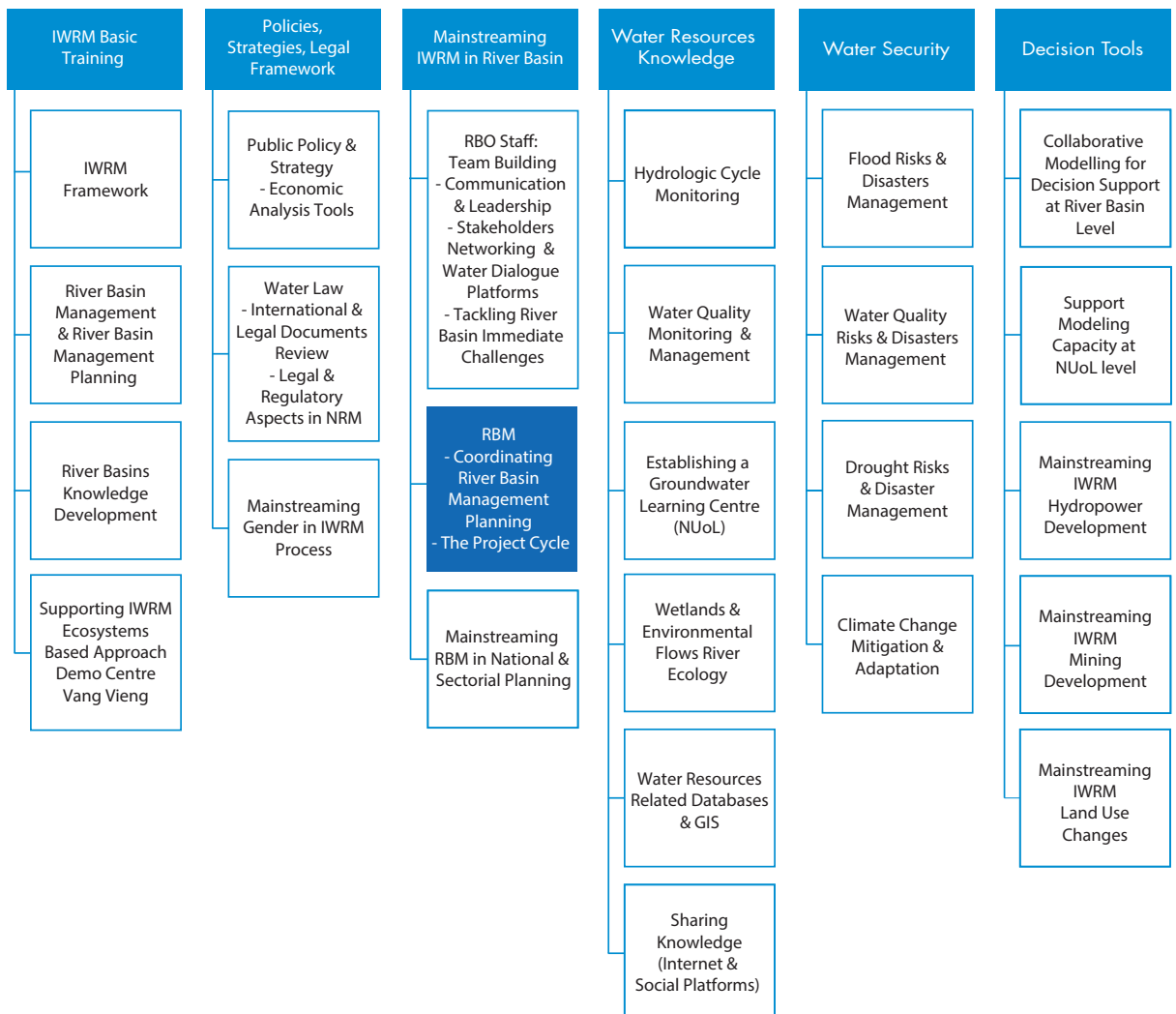
11. <http://www.adb.org/projects/operations>

12. <http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/0,,contentMDK:20120731~menuPK:5068121~pagePK:41367~piPK:51533~theSitePK:40941,00.html>





**Figure 18: Training Plan Organization Chart**



## B. Expected Outputs

The expected outputs are:

1. Understanding the concepts of logical framework – meaning essentially that it is important to keep in mind that the project activities must be consistent and be considered as a whole to reach targets and objectives.
2. Understand project planning, identification of resources and budget: Activities that are delayed may jeopardize or hinder the completion of the other activities and therefore decrease substantially the project effectiveness and efficiency and provide limited delivery of outputs.
3. Understand concepts and methodology of monitoring and evaluation (e.g. indicators, effectiveness, efficiency...)
4. Understand that delaying project activities by inadequate planning and by lack of flexibility in applying the procedures may eventually be very expensive.
5. Get a better mutual understanding between Technical Staff and Admin & Finance Staff regarding their respective duties and responsibilities, balancing planning concerns and margins for flexibility, in such a way that components outputs can be reliably, timely and transparently delivered.

## C. Main Topics Covered

The topics that will be covered by this training are listed below:

### Logical Framework Approach:

1. Analysis of the situation and issues (where we are), establishment of Objectives (general and specifics) and deliverable outputs (where we want to go)
2. Identify consistent package of activities that together will allow fulfilling the specific objective and project outputs (how do we get there).
3. Identified resources needed for carrying out the activities and the related budget

**Project planning, resources and budget:** Methods of planning (bar chart, critical path method), planning of resources, planning cash flow and funds replenishment.

### Monitoring review and reporting:

4. Presentation of basic concepts of Monitoring and reporting
  5. Indicators to be defined when drafting the logical framework
  6. Base-line survey and monitoring during project implementation
  7. Concepts of efficiency and effectiveness
- ### Review and compare ADB, WB and Lao PDR administrative and Financial procedures:
8. Procurement and contract awarding process
  9. Budget control
  10. Cash flow management
  11. Accountancy and financial auditing compliance

Identify concerns and FAQ for allowing a more reliable and timely delivery of the outputs.

## D. Methodology

The Training will be organized using the following modalities:

**Formal Presentation:** Definition and concepts for:

1. Logical Framework;
2. Project Planning;
3. Monitoring and evaluation;
4. Admin & finance tools.

### Discussions/FAQ:

1. Key issues that make that use to hinder the smooth implementation of project

### Group Exercise:

1. Cases Analysis - From a project description, build the logical framework, the planning of the activities (CPM) and the indicators for monitoring and evaluation.

## E. Modules

Modules	Brief Content	Program	Resource Person
<b>Module 1: Logical Framework Design Tools</b>	<ul style="list-style-type: none"> <li>• Identification of issues</li> <li>• Definition of objectives</li> <li>• Outputs</li> <li>• Activities</li> <li>• Resources</li> <li>• Budget</li> </ul>	Formal presentation of the concepts	Lecturer
<b>Module 2: Exercise</b>	From example of project description <ul style="list-style-type: none"> <li>• Build a logical framework</li> </ul>	Groups	Facilitator
<b>Module 3: Planning Of Activities</b>	<ul style="list-style-type: none"> <li>• Planning tasks</li> <li>• Planning resources</li> <li>• Planning budget and cash flow</li> </ul>	Formal presentation of the concepts	Lecturer
<b>Module 4: Exercise</b> Planning & Implementation Tools	From example of project description <ul style="list-style-type: none"> <li>• Planning chart</li> <li>• Resources</li> <li>• Planning budget and cash flow</li> </ul>	Groups	Facilitator
<b>Module 5: Monitoring and Evaluation</b>	<ul style="list-style-type: none"> <li>• Identification of Indicators</li> <li>• Indicators monitoring</li> </ul>	Formal presentation of the concepts	Lecturer
<b>Module 6: Exercise</b> Monitoring Tools	From example of project description <ul style="list-style-type: none"> <li>• Identification of indicators</li> <li>• Baseline survey, monitoring</li> <li>• Evaluation concepts</li> <li>• Reporting</li> </ul>		Facilitator
<b>Module 7: Admin &amp; Finance Tools</b>	<ul style="list-style-type: none"> <li>• Procurement</li> <li>• Budget control &amp; cash flow</li> <li>• Rules for financial auditing compliance</li> </ul>	Formal presentation of the concepts	Lecturer

Modules	Brief Content	Program	Resource Person
<b>Module 8: Key Issues Related to Project Management</b>	What we must do to improve the implementation of the components (reliability, timing, transparency)	Group discussion	Facilitator

## F. Target Components/Focal Points

All managers of the components (1 technical staff, 1 admin Staff) \* 8 components = 16 participants

## G. Time Frame

Day 1: M1, M2

Day 2: M3, M4

Day 3: M5, M6

Day 4: M7, M8





## III. Training Program Agenda

### Day 1

Time	Program	Resource Person
<b>Session 1: Project Cycle Management and Logical Framework Analysis and IWRM</b>		
8:30-8:45	Welcome speech	Director of Training Unit
8:45-9:00	Introduction of the training	CTA
9:00-9:30	Introduction of participants and expectations	Program Facilitator
9:30-10:00	Project, scope of intervention and the design of project components; Terms and definitions	Training Specialist
10:00 -10:20	Break	Admin team
10:20 –12:00	Concept of PCM & IWRM Results-chain Input (duration, budget & resources) and output (products & services) <i>Keynote presentation 1</i>	Training Specialist
12:00-13:30	Lunch	Admin team
13:30-15:00	Group assignments: project presentations by participants	Training Specialist
15:00-15:20	Break	Admin team
15:20-16:30	Case study & group exercise: small-scale water resource development project to demonstrate stakeholder analysis and strategic design of its components. <ol style="list-style-type: none"> <li>Participatory Community-based Fishery Project;</li> <li>Mon River Water Quality Monitoring Project in Vang Viang, Vientiane Province;</li> <li>Community Awareness Raising for Water Resource Preservation Project;</li> <li>Reservoir Operation and Maintenance Project in Savannakhet;</li> <li>IWRM Training Project (nation-wide);</li> <li>Waste Water Treatment Project in Hangkai Village, Xayxettha District, Vientiane</li> </ol>	Training Specialist

## Day 2

Time	Program	Resource Person
8:30-8:45	Recap from day 1	Group Representatives
<b>Session 2 Activity &amp; Work Breakdown Structure, Critical Path Method &amp; Implementation Plan Formulation, Assumption and Risks Analysis</b>		
8:45-09:30	Group Exercise – goal & objective formulation, impact, outcome and output assignment, activity breakdown	Training Specialist
09:30-10:30	Technique in assigning indicators and sources of verification Duration, budget allocation & resource assignment	Training Specialist
10:30-10:50	Break	
10:50-12:00	Project implementation plan formulation <i>Keynote presentation 2</i>	Training Specialist
12:00-13:30	Lunch	Admin team
13:30-15:00	Assumption, risk analysis and risk mitigation measures	Training Specialist
15:00-15:20	Break	Admin team
15:20-16:30	Group exercise – LFA development	Training Specialist
18:30	Dinner	Admin team



## Day 3

Time	Program	Resource Person
8:30-8:45	Recap from day 2	Group representative
8:45-10:00	Presentations by participants	Training Specialist
10:00-10:20	Break	Admin team
<b>Session 3 Monitoring and Evaluation</b>		
10:20-12:00	Monitoring and evaluation – concept & practices <i>Keynote presentation 3</i>	Training Specialist
12:00-13:30	Lunch	Admin team
13:30	Applications to IWRM project management in Lao PDR	Training Specialist
15:00-15:20	Break	Admin team
15:20-16:30	Wrap-up Questions & answers Next steps Feedback & evaluation Closing	Training Specialist
16:30	Travel back home	Admin team



# IV. Training Materials

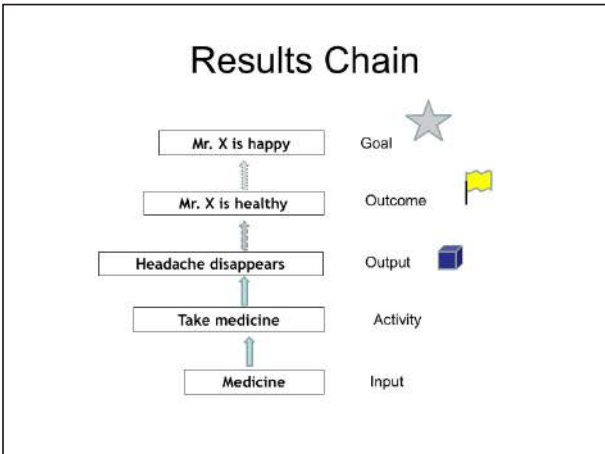
## Keynote presentation 1: Logical Framework Analysis (English)

**PROJECT CYCLE MANAGEMENT**

LFA Conventions

**Results Chain**

- Mr. X has a headache > Scope of problem
- He needs medication > Situation Analysis
- Medicine > Input
- Taking it > Activity
- Headache disappears > Output
- Mr. X is Healthy > Objective
- Mr. X is happy > Goal





# PROJECT CYCLE MANAGEMENT

## Reporting

### Management

#### Management Unit

- Establish policy and strategy
- Steer project direction
- Minimize risks & fill gaps
- Coordinate and maximize results
- Periodic M&E

2

### Implementation

#### Implementation Team

- Ensure effectiveness & efficiency
- Utilize budget & resources
- Maintain schedule
- Deliver results

3

# PROJECT CYCLE MANAGEMENT

## Monitoring & Evaluation

### วงจรการบริหารโครงการ



### What is Monitoring all about?





# **Training Manual for Introduction to Groundwater Management**





# I. Fact Sheet

Name of training course:	<b>Introduction to Groundwater Management</b>
Level and specialty:	Introductory and specialization
After the training, the trainees will:	<ol style="list-style-type: none"><li>1. Understand basic knowledge and characteristic of groundwater occurrence and flow.</li><li>2. Be able to understand the concept of head and hydraulic gradient to construct water table maps.</li><li>3. Understand how to conduct electrical resistivity profiling.</li><li>4. Understand the procedures involved in well construction and test pumping.</li><li>5. Bring together all information gathered to build simple groundwater models.</li></ol>
Target groups:	<ul style="list-style-type: none"><li>• Staff and students of the National University of Laos (NUOL), Faculty of Water Resources, Faculty of Engineering, and Faculty of Science.</li><li>• Governmental water agencies and staff at central, provincial, district and sub-district levels.</li></ul>
Number of training days:	13 days
Dates and venue of training:	<p>The Introduction of Groundwater Management Course consists of 5 training modules which include:</p> <ul style="list-style-type: none"><li>• Introduction of Groundwater Module, 12-14 October 2015.</li><li>• Resistivity Survey Module, 16-17 October 2015.</li><li>• Borehole Drilling Preparation, Drilling and Pump Testing Module, 18-21 October 2015.</li><li>• Groundwater Modelling Module, 15 and 22-23 October 2015.</li><li>• Field Trip and Study Tour at IWMI's Groundwater Pilot Demonstration Site, Bann Akksang, Vientiane Province, 2 November 2015.</li></ul> <p>Venues: National University of Laos, Faculty of Engineering, Sopaluang Campus, and Faculty of Water Resources, Tadthong Campus</p>
Number of trainees:	40 Trainees (15 women and 25 men)
List of trainees:	See Annex A-7
List of principal trainers:	<p>The resource people involved were from the Faculty of Engineering (FE), the Faculty of Natural Sciences (FNS), and the Faculty of Water Resources (FWR).</p> <p>The training instructors were Ms. Keophousone Phonhalath (FE), Mr. Saykham Sithavong (FWR), and Mr. Nicholas Lombardi (International consultant), Dr. Paul Pavelic, Program Director and his IWMI team.</p> <p>Training facilitator, Mr. Suparerk Janprasart, Chief Technical Advisor and Team Leader.</p>

#### Training methodologies:

The training was divided into five different modules covering various aspects of groundwater study which utilized the following methodologies:

- Keynote presentations and interactive discussions prepared and facilitated by trainers;
- Participatory classroom exercises;
- Fieldwork covering resistivity profiling, borehole drilling, borehole survey, and pump testing, and;
- Field trip and study tour in local stakeholder interviews.

#### Training materials:

1. Situational Analysis, Training Concepts and Training Modules
2. Training Program Agenda with Training Methodologies
3. Power Point Presentations
4. Resource Materials in PDF format
5. Groundwater Software for Visualization, Analysis, and Modeling
6. Keynote Presentations
7. Review Xam Covering All Major Aspects of the Training
8. Short Video Documentaries

#### Recommended additional reference materials:

1. Oregon State University Groundwater tutorial:  
[https://media.oregonstate.edu/media/t/0\\_ad6n8ghc](https://media.oregonstate.edu/media/t/0_ad6n8ghc)
2. Water Well Drilling:  
[http://www.lifewater.ca/drill\\_manual/Section\\_Tutorial.htm](http://www.lifewater.ca/drill_manual/Section_Tutorial.htm)
3. Introduction to the resistivity surveying method:  
<http://www.geo.mtu.edu/~ctyoung/LOKENOTE.PDF>
4. <http://www.novamatrixgm.com/visual-modflow/visual-modflow-flex-tutorials>

#### Training assessment results and findings:

This intensive training was designed to provide knowledge about groundwater flow and occurrence, and the utilization and management of this resource. It was jointly organized by ADB-TA7780 NIWRMSP project team and the NUOL.

The training successfully provided participants the basic skill in groundwater assessment and analysis, which can augment further studies in this field. The trainees participated in hands on field activities and expressed great enthusiasm in the methods that were introduced.

Towards the end of the training, a difficult exam covering all aspects of the course was given in which 84% of the students got grades greater than 60, showing excellent comprehension of the material that was taught. Trainees expressed great interest in a second course of this kind. The overall score of this training rated by the trainees was **7.5 out of 10**.

#### Next steps and Recommendations:

1. Additional trainings in groundwater encompassing both classwork and fieldwork should be conducted. A proposal for the next training is included in Appendix 1.
2. Organize similar training once a year to expand the trainee base and reinforce the principles of groundwater assessment and management.
3. Disseminate information of this activity to donors for fund raising purpose.

## II. Situation Analysis, Training Concepts and Training Modules

### A. Justification

For decades, little interest has been shown in groundwater resources in Lao PDR, despite the fact that 80% of the rural population depends on groundwater in some form. Although Lao PDR has vast surface water resources they are not accessible to those who live at a distance from them. Drinking water supply and some punctual industrial spots were the only users of the groundwater resources. Most of the water produced for domestic purposes, especially in villages and even small towns, comes from dug wells which are unreliable and pose health risks.

In many countries, groundwater is of vital importance for the livelihood and health of the people since it is often the main source for domestic water. It is also widely used for irrigated agriculture and for industry. This is particularly true in dry regions where surface water is scarce or seasonal, and in rural areas with dispersed populations. Climate change is likely to lead to a greater dependence on groundwater as a cushion against drought and increasing uncertainty in surface water availability. Up to now, indeed, groundwater exploitation remained very limited in Lao PDR, but it is likely to change fast in the short and middle term. This situation is already changing, at least in some places of Lao PDR for different reasons:

- The generalization of electricity supply in most part of the rural areas resulted in the replacement of the hand pumps by electric pumps. This generated opportunities for the private sector (boreholes drilling, pumping stations and mini water supply networks). The water consumption increased for domestic use electric pumps could also provide more flexibility and more yield for gardening purposes.
- The rapid development of some urban areas, and the extension of industrial facilities and mining activities also generated increasing demand for groundwater use.

Lao PDR is just starting now to seriously assess its groundwater resources and to consider the potential and the risks of groundwater development. Just recently, the Government of Lao PDR has included groundwater in its national policy and has created a Groundwater Management Division under the Department of Water Resources.

But despite the importance of groundwater to national development and the growing recognition of its value, there is insufficient capacity of groundwater experts in the country. It means that institutional development and capacity building activities, for the meantime, are very limited and that these areas will require important and long term efforts in terms of implementation and capacity building. There is therefore a strong need to increase capacity and knowledge regarding the groundwater sector at all levels: institutional, technical and managerial.

A major step in improving this situation was the inclusion of the ADB-Component 3 of the NIWRMSP "Groundwater Resources Assessment". This component is likely a first attempt in Lao PDR to tackle this area in a systematic way. Within the framework of this Component, an overall assessment of groundwater resources is being carried out starting with a consultation process that led to the formulation of an action plan that should address 5 "categories": (i) the institutional settings and capacity; (ii) the regulatory framework; (iii) the groundwater management and strategic planning (data base, inventories and analysis); (iv) the users involvement (awareness, education, local monitoring), and; (v) capacity building and training.

This last category is now being addressed with pragmatic efforts designed to increase the proficiency required to characterize and administer groundwater resources, and to this end two related tasks have been drafted:

- Training for groundwater field technicians (in coordination with the Groundwater Research Center (GRC) at Khon Khaen University).
- Development and strengthening curriculum for (i) groundwater managers and (ii) for hydrogeologists both a NUOL and foreign Universities (in progress).

The training for groundwater field technicians is part of this training module, with an aim of extending the audience and re-situating the very technical issues within a more general IWRM context. The training session conducted in October 2015 is a major step in capacity building of this area.

The 'Introduction of Groundwater Management Training Course' described in this document has been carried out under the NIWRMSP (ADB TA No. 7780). The outputs identified at the inception of this TA were grouped into four categories, and implemented by four corresponding component teams:

- Output 1: National capacity built in integrated water resources management (Component 1);
- Output 2: River basin management developed (Components 2a and 2b);
- Output 3: National groundwater management action plan prepared (Component 3); and
- Output 4: Integrated water resources management education strengthened at the National University of Laos (Component 4).

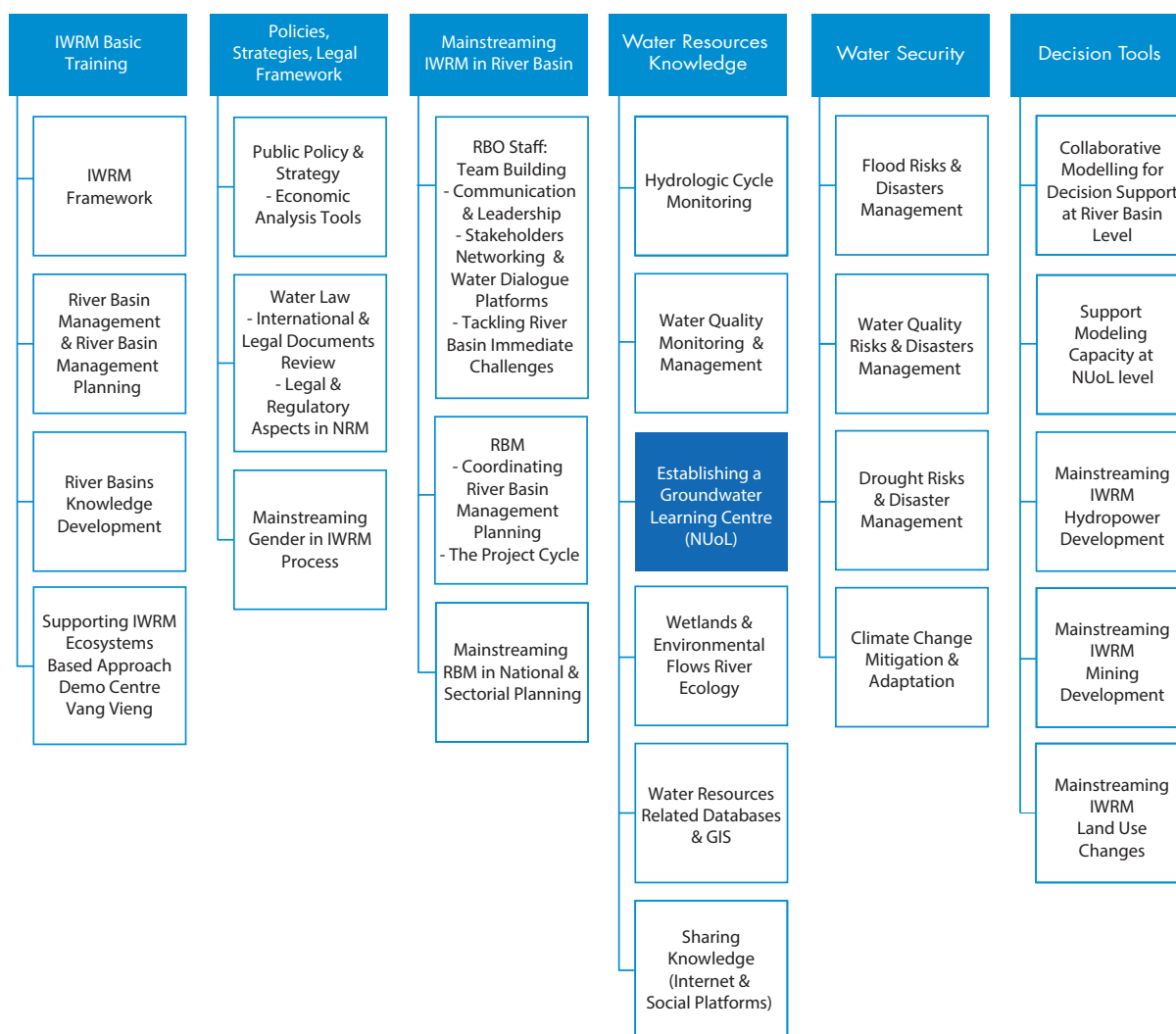
The National Groundwater Action Plan was prepared and submitted by Component 3 in November 2013, and twenty tasks were grouped into five categories:

1. Institutional Settings;
2. Water Law/Regulatory Framework;
3. Groundwater Management and Strategic Planning;
4. User involvement, and;
5. Capacity Building & Training.

A thirteen-day instructional course, conducted in October to early November 2015 over a time span of four weeks and including fieldwork, classroom instruction as well as field study, falls under Category Five of the Groundwater Action Plan, i.e. capacity building and training, and was implemented under the auspices of Components 1 and 4 (with assistance from Component 3) of the abovementioned TA.

The diagram below illustrates the position of this exercise within the overall Component 1 Training Plan:

**Figure 19: Training Plan Organization Chart**





On 22 May 2015, a Kick-off Workshop for Development of Groundwater Management Training was held with over 30 participants, including those from various faculties within NUOL, from NREI, DWR, IWMI, Irrigation Department, and Khon Khaen University, Thailand. The objective of the Workshop was to agree upon the groundwater management training plans and activities. The output of the workshop was a preliminary design of introduction of groundwater training course that consist of five training modules. The course would be the very first multi-disciplinary program that would include key trainers from different faculties and key governmental agencies. The five training modules that will include:

1. Introduction of Groundwater (three-day lecturing and classwork module);
2. Resistivity Survey (two-day field exercise module);
3. Borehole Drilling Preparation, Drilling and Pump Testing (four-day field exercise and classwork module);
4. Groundwater Modelling (three-day field exercise module), and;
5. Field Trip and Study Tour (one-day field trip module).

The expected outputs from the training program were identified as:

1. Capacity strengthening and developing skills in ground water management encompassing basic knowledge and use of the resource, and borehole survey/drilling and supervision;
2. Upgrading of the undergraduate course module and building a foundation for a graduate program of groundwater studies;
3. Relative ground water mapping, and;
4. Creation of a Groundwater Training pilot site in Tad Thong Campus, Faculty of Water Resources of NUOL.

During and after the training, the trainees are expected to be able to provide constructive inputs for the development of the GW Research and Training Center, its goals, building requirements, and key action plans in order to make the Ground Water Research Center happened in the next 3 to 5 years. It was agreed that the target groups of the trainees should consist of:

1. Professors, lecturers and prospect students from Water Resources and Environmental Engineering Faculty, and;
2. Key concerned agencies such as NREI, DWR, Public Work, etc.

A key feature of this intensive training course, organized in early October to early November 2015 was that the organization and actual execution was carried out by an inter-faculty group of the National University of Laos (NUOL), laying down a foundation for the establishment of a Groundwater Research and Training Center at NUOL, a component which is briefly discussed at the end of this document. The resource people involved were from the Faculty of Engineering, the Faculty of Natural Sciences, and the Faculty of Water Resources. The resource people involved were from the Faculty of Engineering (FE), the Faculty of Natural Sciences (FNS), and the Faculty of Water Resources (FWR). The training instructors were Ms Keophousone Phonhalath (FE), Mr. Viengthong Xayyavong (FNS), Mr. Saykham Sithavong (FWR), Mr. Nicholas Lombardi (International Consultant), and Dr. Paul Palvelic, Program Director, IWMI and his team. The training was held on the Sophaluang Campus, Faculty of Engineering, and the Thadthong campus of the Faculty of Water Resources, National University of Laos. For the field study, it would be held in Bann Akksang, Vientiane Province, a ground water research pilot of IWMI.

This document will be uploaded to the Lao PDR Ministry of Natural Resources (MONRE), Department of Water Resources (DWR) IWRM Framework NIWRMSP Platform website: <http://www.riversweb.org/monreCBP>.

## III. Training Program Agenda

Module	Date	Team Leader	Venue
<b>1) Introduction to Ground Water</b>	12-14 Oct	Ms. Keophousone	Faculty of Engineering, Sokpaluang campus
<b>2a) Resistivity survey</b> Groundwater hydraulics and review of concepts in Module 1	16-18 Oct	Mr. Viengthong	Water Resources Faculty, Thadthong Campus
<b>2b) Resistivity Survey: Fieldwork</b>			
<b>3) Borehole drilling and pump testing</b>	19-20 Oct	Mr. Saykham	Water Resources Faculty, Thadthong Campus
<b>4a) GW Modeling I</b> Overview - Groundwater hydraulics and review of concepts in Module 1	15 Oct	Mr. Nicholas Lombardi	Faculty of Engineering, Sokpaluang campus
<b>4b) GW Modeling II</b> Review of aquifer properties and parameters required for modeling; creation of simple steady-state model.	22 Oct	Mr. Nicholas Lombardi	Faculty of Engineering, Sokpaluang campus
<b>4c) Modeling III</b> Synthesis of material learned to create groundwater models Varying properties and parameters to see the effects on the model Summary & conclusions Exam and student feedback	23 Oct	Mr. Nicholas Lombardi	Faculty of Engineering, Sokpaluang campus
<b>5) Study Tour at IWMI project</b>	2 Nov	IWMI	Bann Akksang
<b>Feasibility study for Groundwater Center</b> Brainstorming meeting for the design and formation of a groundwater training and research center	26 Oct	All instructors together with other relevant resource people	Faculty of Engineering, Sokpaluang campus

# IV. Training Materials

## Module 1: Introduction of Ground Water

The first three days were dedicated to covering all the basic concepts required for the advanced modules that followed. It is important to note that the topics presented encompassed material that a student would learn in a three month semester groundwater course. Therefore it was not expected that all students would grasp all concepts to the same degree, rather the main objective was to give them the overall picture of what groundwater study entails.

The different nature of surface water and groundwater, the hydrological cycle, occurrence of groundwater in various forms (perched, unconfined, and confined aquifers), geological deposits and how they affect groundwater flow were covered in the lectures. Aquifer analysis via the Hvorslev method was done as a class exercise, and a master's thesis of a water balance study was presented on day two.

Concepts were reinforced through hands on exercises such as drawing of flownets, the contouring of water table maps both by hand and using the software SURFER.



## Keynote presentation 1-5: Introduction of Ground Water (Lao and English)

National University of Laos



ວິສະວະກຳນ້ຳໄຕ້ດິນ  
“ ບົດທີ 1. ການເກີດຂອງນ້ຳໄຕ້ດິນ **Occurrence of Ground Water**”

ປັນຍາຍໂດຍ: ດຣ. ແກ້ວພູສອນ ພິນທາລາດ  
By: Dr. Keophousone PHONHALATH

National University of Laos



ວິສະວະກຳນ້ຳໄຕ້ດິນ  
“ ບົດທີ 2. ຄຸນລັກສະນະຂອງດິນ **Soil Characteristics**”

ປັນຍາຍໂດຍ: ດຣ. ແກ້ວພູສອນ ພິນທາລາດ  
By: Dr. Keophousone PHONHALATH

National University of Laos



ວິສະວະກຳນໍ້າໃຕ້ດິນ

“ ບົດທີ 3.ການແບ່ງປະເພດຂອງຊັ້ນໃຫ້ນໍ້າ Aquifer Types”

ປັນຍາຍໂດຍ: ດຣ. ແກ້ວພູສອນ ພິນທາລາດ  
By: Dr. Keophousone PHONHALATH

National University of Laos



ວິສະວະກຳນໍ້າໃຕ້ດິນ

“ ບົດທີ 4.ການໄຫຼຂອງນໍ້າໃຕ້ດິນ Groundwater flow system”

ປັນຍາຍໂດຍ: ດຣ. ແກ້ວພູສອນ ພິນທາລາດ  
By: Dr. Keophousone PHONHALATH

National University of Laos



ວິສະວະກຳນໍ້າໃຕ້ດິນ

“ ບົດເລິກຫັດ ວິເຄາະແລວການໄຫຼຂອງນໍ້າໃຕ້ດິນ”

ປັນຍາຍໂດຍ: ດຣ. ແກ້ວພູສອນ ພິນທາລາດ  
By: Dr. Keophousone PHONHALATH



# Paper 1: Basic concept of groundwater (Lao)

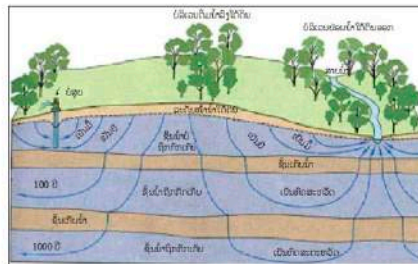
## 1.1 ນິຍາມຂອງນໍ້າ

ນໍ້າເປັນສານເຄມີທີ່ປະກອບດ້ວຍໄຮໂຕຣເຈນກັບອອກຊີເຈນມີສູດທາງເຄມີແມ່ນ  $H_2O$  ນໍ້າຈະມີຄວາມໜາແໜ້ນທີ່ສູດໃນອຸນຫະພູມ  $4\text{ }^{\circ}C$  ແຂງຕົວທີ່ອຸນຫະພູມ  $0\text{ }^{\circ}C$  ແລະ ມີຈຸດຟືດຢູ່ທີ່ອຸຫະພູມ  $100\text{ }^{\circ}C$ . ນໍ້າເປັນຕົວນໍາຄວາມຮ້ອນໄດ້ດີທີ່ສຸດ.

## 1.2 ນິຍາມຂອງນໍ້າໜ້າດິນ ແລະ ນໍ້າໃຕ້ດິນ (Definition of surface water and groundwater)

ນໍ້າໜ້າດິນເປັນແຫຼ່ງນໍ້າທີ່ພົບເຫັນທົ່ວໄປໃນທໍາມະຊາດເຊັ່ນ: ຫ້ວຍ, ໜອງ, ຄອງ, ບຶງ ແລະ ແມ່ນໍ້າ ລໍາເຊ. ແຫຼ່ງນໍ້າໜ້າດິນເປັນນໍ້າທີ່ມີການປົນເປື້ອນສານເຄມີ ແລະ ມີເຊື້ອພະຍາດທີ່ເຈືອປົນຢູ່ນໍ້າບໍ່ເໝາະ ສົມທີ່ ຈະນໍາມາໃຊ້ດື່ມ ໂດຍບໍ່ໄດ້ຮັບການປັບປຸງຄຸນນະພາບເສຍກ່ອນ ແຕ່ນໍ້າຈໍາພວກນີ້ແມ່ນມີປະລິມານຫຼາຍ ແລະ ຫາໄດ້ງ່າຍ ອາດຈະພົບເຫັນໃນທຸກຫົນແຫ່ງໃນທໍາມະຊາດ ຈຶ່ງນິຍົມນໍາມາປັບປຸງຄຸນນະພາບໃຫ້ເໝາະສົມ ເພື່ອ ບໍລິໂພກເຊັ່ນ: ນໍາມາໃຊ້ຜະລິດນໍ້າປະປາເປັນຕົ້ນ.

ນໍ້າໃຕ້ດິນເປັນນໍ້າທີ່ມີການເກັບກັກຕາມທໍາມະຊາດເປັນເວລາຫຼາຍຮ້ອຍຫຼາຍພັນປີ ພາຍໃຕ້ພື້ນດິນທີ່ ຂັງຢູ່ຕາມ ຊ່ອງຫວ່າງຂອງເນື້ອດິນ ແລະ ຫົນທີ່ນໍ້າເກືອບຊຶມຜ່ານບໍ່ໄດ້. ນໍ້າໃນດິນນີ້ຖືວ່າເປັນ ບ່ອນເກັບກັກ ຂອງຊັບພະຍາກອນທໍາມະຊາດປະເພດທີ່ໃຊ້ແລ້ວໝົດໄປ, ເຖິງຈະມີບາງສ່ວນທີ່ໜ້ອຍທີ່ໄຫຼກັບ ຄືນຈາກການ ໄຫຼຊຶມຜ່ານ ຜິວດິນຂອງນໍ້າຈາກຝົນທີ່ຕົກລົງມາ ຫຼື ຈາກການລະລາຍຂອງຫີນເມະ ຫຼື ສາຍທາງຂອງ ນໍ້າແຂງ. ແຫຼ່ງນໍ້າໃຕ້ດິນສ່ວນໃຫຍ່ເປັນນໍ້າສະອາດໂດຍນໍ້າທີ່ຂັງຢູ່ໃຕ້ດິນນັ້ນມາຈາກນໍ້າທີ່ຊຶມຜ່ານການກັ່ນຕອງ ຂອງຊັ້ນ ດິນ, ຫີນແຮ່, ຫີນຊາຍມາແລ້ວຫຼາຍຊັ້ນ.



ຮູບທີ 2.10. ລະບົບນໍ້າໃຕ້ດິນ

(ຈາກ: [http://www.usbr.gov/lc/yuma/programs/YAWMS/GROUNDWATER\\_aquifer.html](http://www.usbr.gov/lc/yuma/programs/YAWMS/GROUNDWATER_aquifer.html))

## 1.3 ແຫຼ່ງນໍ້າ (Water Resources) ແລະ ຄຸນນະພາບ

### 1.3.1 ແຫຼ່ງນໍ້າ

ເຖິງວ່ານໍ້າ ຈະມີຢ່າງຫຼວງຫຼາຍເທິງໜ້າໂລກ ແຕ່ຄວາມສາມາດທີ່ຈະໃຊ້ມັນໃນແຕ່ລະບ່ອນຈະບໍ່ເທົ່າ ທຽມກັນ ຍ້ອນເຫດຜົນສອງ ປະການຄື:

ການແຈກຢາຍຂອງນໍ້າໜ້າໂລກມີບໍ່ສະໝໍ່າສະເໝີ ບາງບ່ອນມີເກີນຄວາມຕ້ອງການ, ບາງ ບ່ອນມີໃຊ້ໜ້ອຍດຽວ. ບ່ອນມີນໍ້າອຸດົມສົມບູນ ມັກມີປະຊາກອນໜາແໜ້ນ ແລະ ອຸດສາຫະກໍາຫຼາຍ.

## Module 2a: Resistivity survey: Groundwater hydraulics and review of concepts in Module 1

This module concentrated on the hydraulic aspects of groundwater flow: the explanation of 'head' as the energy driving groundwater flow, distribution of head and the establishment of the hydraulic gradient that determines flow direction, analysis of hydraulic conductivity and transmissivity and the application of Darcey's Law to a real field situation on the Vientiane Plains. The lecture concluded with the

storage properties of aquifers and the calculation of groundwater velocities.

To help visualize patterns of groundwater flow, the software TopoDrive was used by the students in a series of class exercises that illustrated the relationships between heads and flows.

### Keynote presentation 6: Electrical Resistivity Survey - Groundwater hydraulics and review of concepts in Module 1 (Lao and English)



 “Groundwater Management Training” 

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**ການສຳຫຼວດຄວາມຕ້ານໄຟຟ້າຈຳເພາະ**  
**Electrical Resistivity Survey**

*Viengthong Xayavong (MSc. in Geophysics)*  
*Geophysics Unit*  
*Department of Physics*  
*Faculty of Natural Science, NUOL*  
*E-mail: [viengthongxv@gmail.com](mailto:viengthongxv@gmail.com)*

*Tadthong, 16-17 October 2015*

## Module 2b: Resistivity Survey - Fieldwork

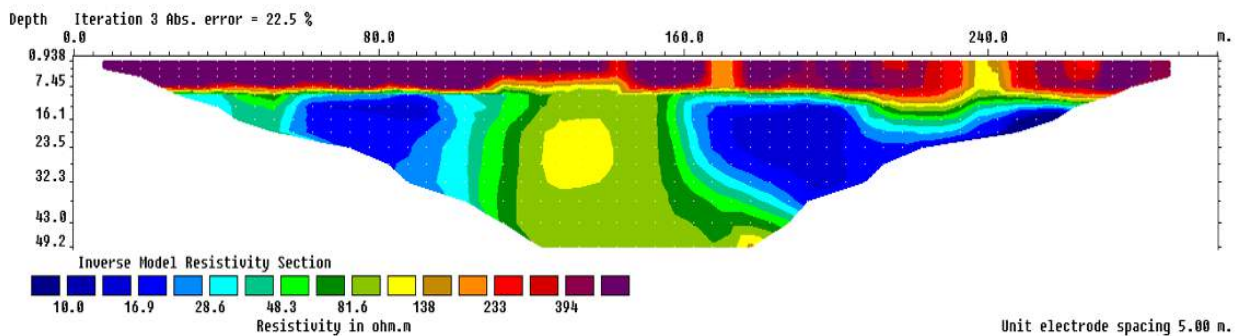
On the fifth day of the training, the electrical properties of rocks and theory of resistivity took place in the morning, and practice with the required modeling software was the afternoon's activity. Emphasis was on the application of the techniques for groundwater

exploration. On the next day, students actively participated in conducting a 300 meter long profile using the Wenner array and the analysis of the data was given as homework using RESDINV, the standard software for 2D resistivity modeling.

**Figure 20: Fieldwork as part of the course**



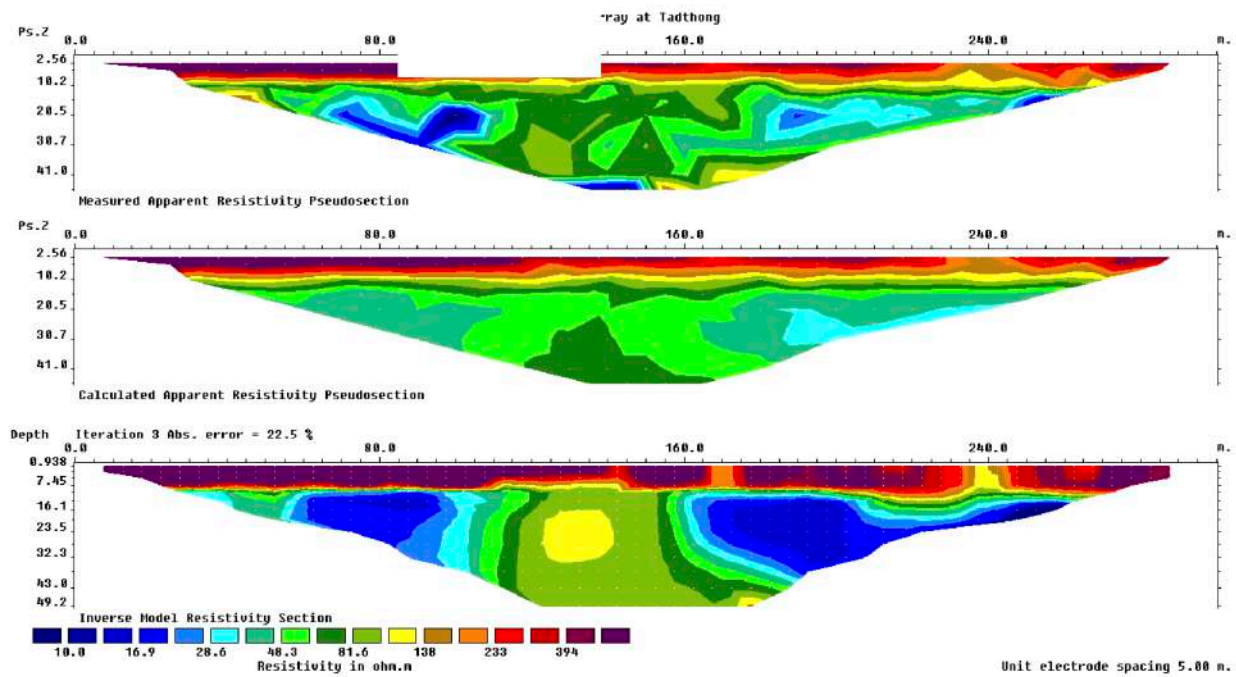
The results are given below:



The resistivity cross section indicates that there two low resistivity zones to the north and south which show the highest potential for groundwater extraction.



## Paper 2: Result of the Resistivity Survey Exercise



## Instruction video 1-5: Field practice on electricity resistivity survey at Tadthong Campus





## Module 3: Borehole drilling and pump testing

Professor Saykham of the Faculty of Water Resources arranged for a drilling contractor to construct a well 60 meters in depth. The method used was air drilling with a compressor. The students took notes while collecting and packaging the drill cuttings as samples with depth. PVC casing was installed and a gravel filter pack was placed, and the well was developed for five hours. The day ended with the students practicing for the pumping test to be held on the following day.

A group of students were also involved in a survey of existing boreholes using leveling equipment and siting off of benchmarks as well as measuring the water levels in the wells for the purpose of creating a map of head distribution on the Tad Thong campus.

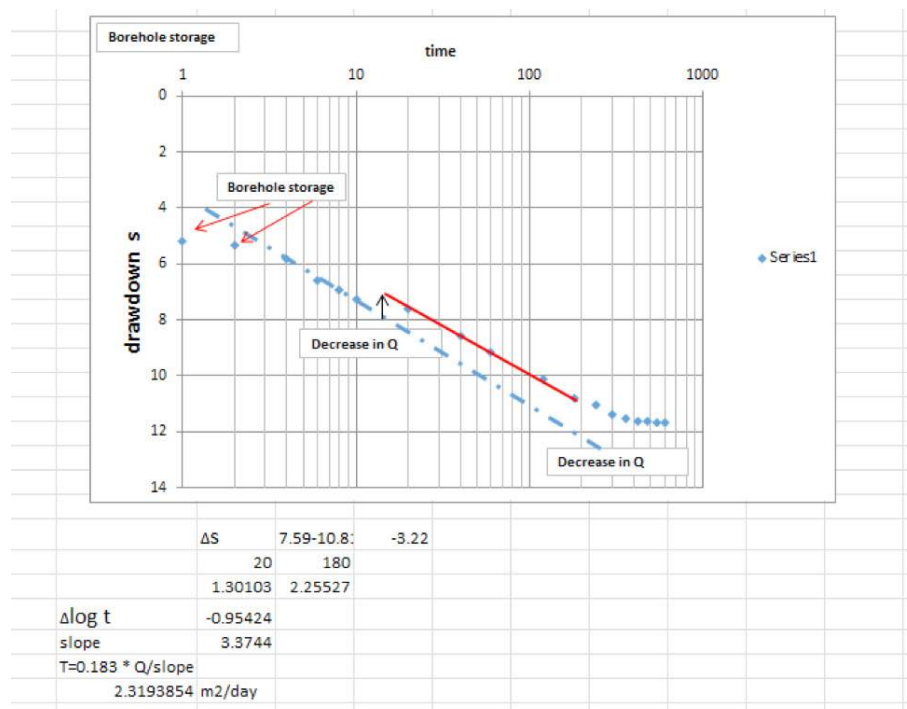
A full pump test was performed the next day for 600 minutes (10 hours) and recovery measurements were taken for the same amount of time after the pump was stopped.

On Thursday, 22 October 2015, the analysis was done in class together with the students using a spreadsheet, and confirmed with pump-testing software (AQUIFERWIN). The students learned the Cooper Jacob straight line method to calculate transmissivity and the results are shown below.

It should be noted that the borehole was located before the resistivity survey due to logistical reasons (establishment of a demonstration irrigation scheme) and the low value of transmissivity, 2.3 m<sup>2</sup> per day and low yield was due to the fact that the well penetrated the high resistivity section in the middle zone. The borehole also confirmed the depth of bedrock predicted by the resistivity survey, around 7.5 meters.



**Figure 21: Transmissivity Calculation Based on Cooper Jacob Straight Line Method**



## TA 7780 Component 3 Pilot Study Training Session

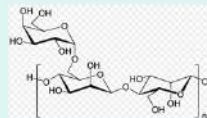
### Drilling methods

- The most common method of drilling in groundwater work is with rotary rigs using drilling fluid to remove the cuttings. The four main types of fluids are
  - 1) bentonite clay mixed in water;
  - 2) natural polymer from the guar seed;
  - 3) Air (with or without water or foam)
  - 4) Only water, with the natural clay in the hole making the water thick

Guar beans



Polymer



## Pumping test description and procedures

### What do we want to know?

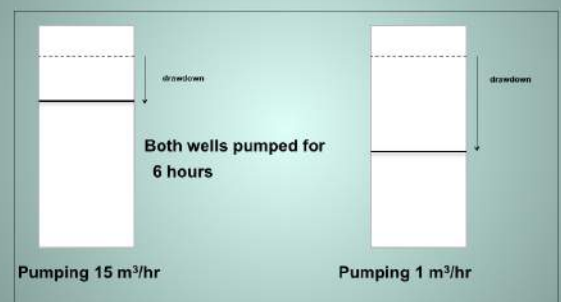
We want to know 2 things:

- how much water can be pumped, and
- How much the water level drops when we pump (drawdown)

Drawdown can be considered the price we pay to pump the water.

The difference between the original water level before the test and the water level at a certain time after the pump was switched on, is the drawdown for that time.

### Which well is more productive?



TA7780  
Package 3 Groundwater Assessment

**National Water Well Database and  
Standardized Water Well Log Sheet**

(content taken from Working Paper Three)

**National Water Well Database**

There are two items that must be standardized before we can use a water well database system

1. Standard well log sheet for the whole country that must be used by ANYONE drilling a well.
2. Standard system of well ID for all water wells

**Well ID**

**Suggested system (similar to Cambodia)**

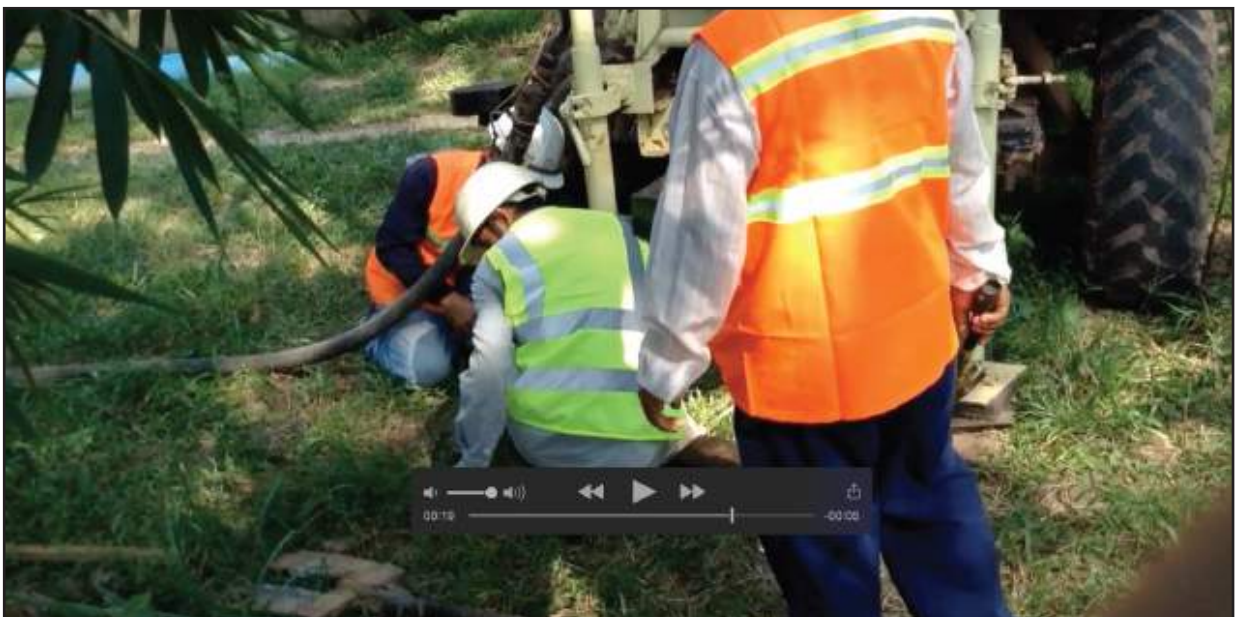
Each well number is built up out of four parts. Each part gives some specific information, and is made up out of letters or numbers. The four parts are:



## Paper 3: National well log sheet

Well's Log						
Project:	Groundwater Project					
Location:	Faculty of Water Resources, NUOL, Tad Thong Campus, VT-LA					
BHNO:	1	Note:	Behind FWR Lab			
X:						
Y:						
Drill by:		Start:	18/10/2015	Finish:	19/10/2015	
Field Supervisor by:						
Depth (m)	Casing/Screen	Well Log	Lithology	WS (m)	Q, m <sup>3</sup> /h	Note
0.2						Casing High
0			Ground Surface			
0.6			Top Soil			
2						
3.5						
4			Medium Sand			
6.5			Fine Sand			
7						
10			Silt Stone			water strike
11.5						
13						
14.5						
15.9						
17.4						
18.9						
19.4						
21.9						
24.9						water strike
26.4						
27						
30.9						Screen Length, 8m
33.9						
35						
36.9						
39						Screen Length, 4m
40						
43						Screen Length, 4m
46						
47						
49						Screen Length, 4m
51						
52						
55						Screen Length, 4m
58						
59						
61						Bottom Cap

## Videos 6-10: Borehole drilling at Tadthong Campus



## Modules 4a: Groundwater Modeling: Overview - Groundwater hydraulics and review of concepts in Module 1

## Modules 4b: Groundwater Modeling: Review of aquifer properties and parameters required for modeling; creation of simple steady-state model.

## Modules 4c: Groundwater Modeling: Synthesis of material learned to create groundwater models, Varying properties and parameters to see the effects on the model, Summary & conclusions, Exam and student feedback

The equations and structure of groundwater models were introduced. Parameters required were reviewed, and the building of the grid explained, focusing on the three types of boundary conditions required to enclose the model domain. The concept of steady state was illustrated and contrasted against transient models.

In the afternoon, a simple steady state 2D groundwater models was constructed using the software Groundwater Vistas and hydraulic conductivity was varied to show the effects on the system consisting of two streams and steady recharge from rainfall (see Figure 22). Students were taught to check their models using a mass balance - the summary of inflows-outflows. A well was later added, and the students were shown how the accuracy of results could be improved by refining the grid (see Figure 23).

The three main phases of groundwater modeling, Calibration, Verification (Validation), and Prediction, were explained to the students with examples given of how the prediction capabilities of modeling can help in resource management, strategic planning, and project design:

### Exam and student feedback

#### Paper 9: Training examination

An exam was given on the last day of the formal training. The questions and answers were given in both Lao and English, but only the English versions are contained in Appendix II.

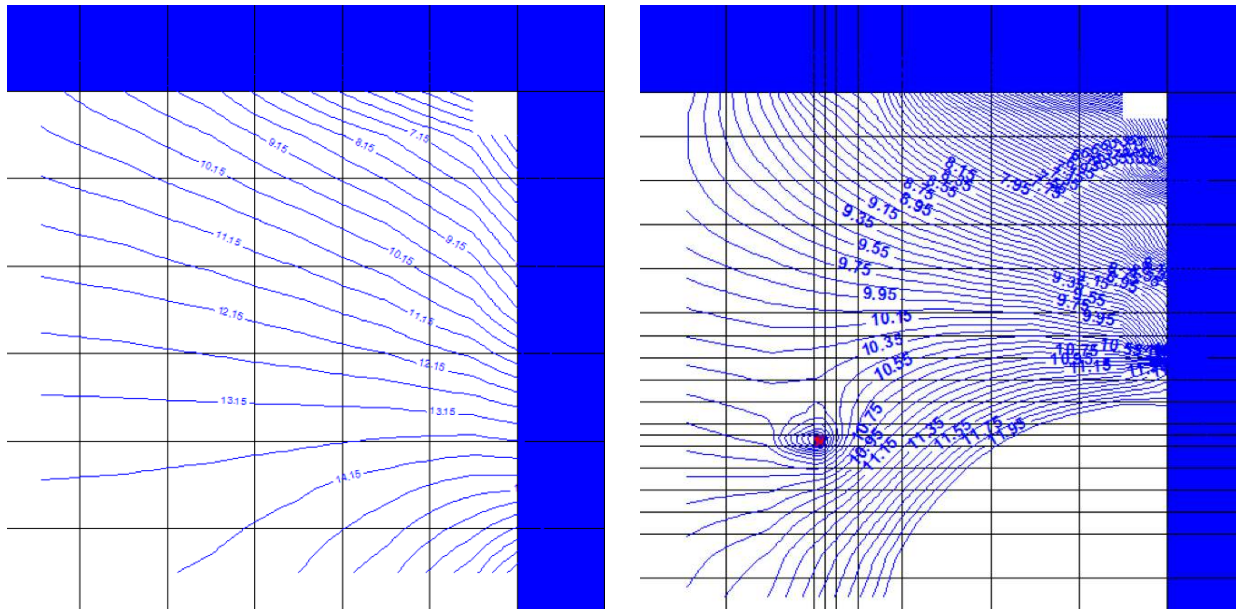
Overall the results are quite good and summarized below:

Score	% of students
45	16%
60	16%
65	11%
75	16%
85	5%
95	37%

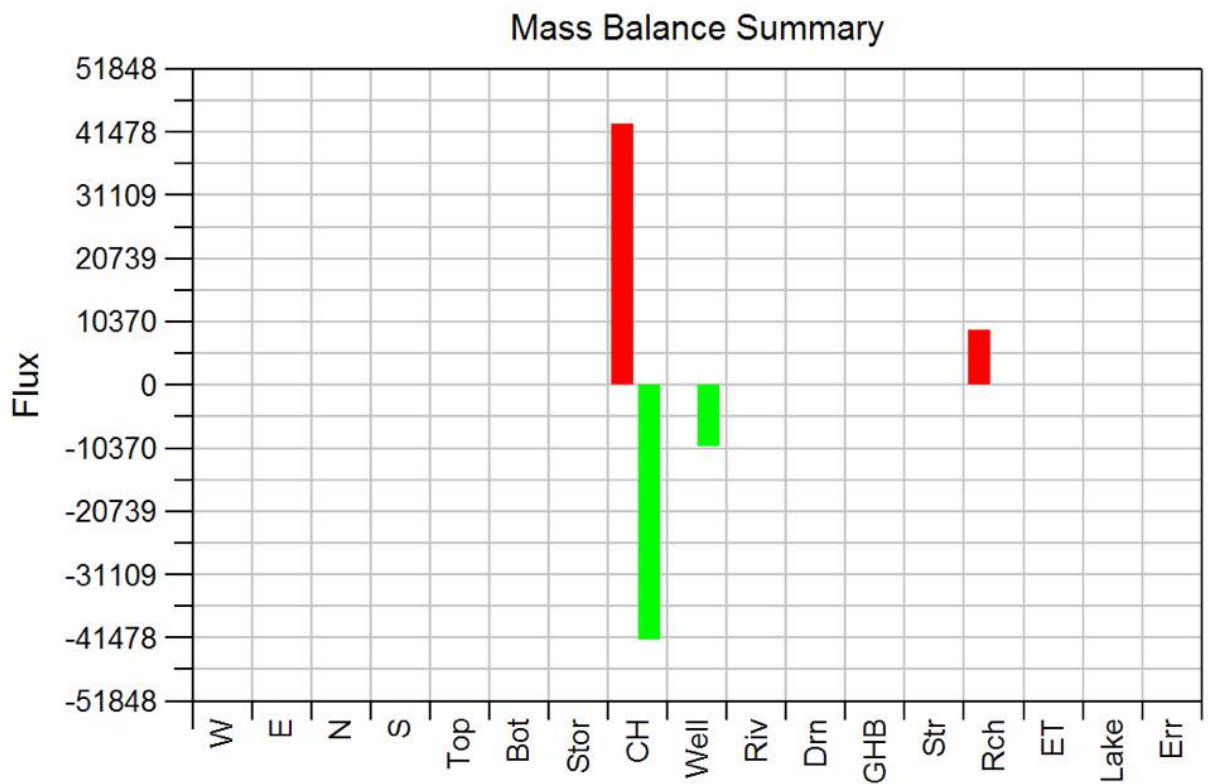
A perfect score would be 100. If the passing grade would be considered as 65, it would mean that 69% of the students passed. If 60% was the passing grade, then 84% of the students passed.

Attendance was also quite good with 50% of the students attending 8 out of the 10 days, while 10 students had 100% attendance.

**Figure 22: Simple steady state model with two streams and constant recharge [left] Model with well added and refined grid [right]**

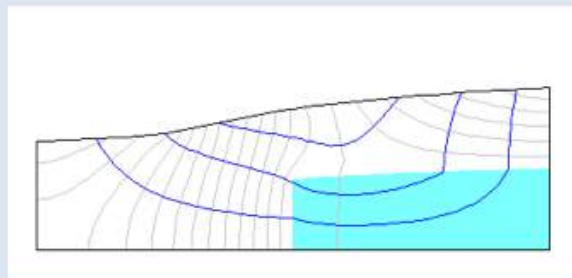


**Figure 23: Mass balance summary for the simple steady models**



## Hydrogeological Modeling

### An introduction to basic concepts



What is a groundwater model?

- Mathematical equations
- Digital/computer representation with graphical results
- Simple simulation of physical processes to understand groundwater behavior.

Mathematical equations

Basic Equation:

$$\frac{\partial}{\partial x} \left( K_{xx} \frac{\partial h}{\partial x} \right) + \frac{\partial}{\partial y} \left( K_{yy} \frac{\partial h}{\partial y} \right) + \frac{\partial}{\partial z} \left( K_{zz} \frac{\partial h}{\partial z} \right) + W(x, y, z, t) = S_s \frac{\partial h}{\partial t}$$

OH MY GOD! WHAT DOES THAT MEAN?

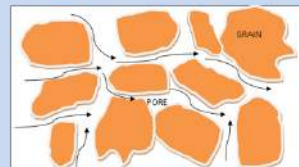


## Hydrogeological Modeling Part 1 - important concepts

Groundwater does **NOT** flow underground like a stream

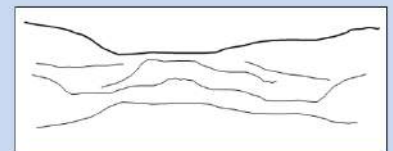
It flows through earth materials in two ways:

1. Through the pore spaces between grains in unconsolidated (soft) deposits such as gravel, sand, and clay
2. Through connected cracks and fractures in hard rocks.



1

2



## Paper 4: Basic concept of groundwater and flows

### ***Nature of Groundwater***

Groundwater does not flow underground like a stream (the exception is karst aquifers, described later in this paper). It flows through earth materials in two basic ways:

- Through the pore spaces between grains in unconsolidated (soft) deposits such as gravel, sand, and clay
- Through connected cracks and fractures in hard rocks.

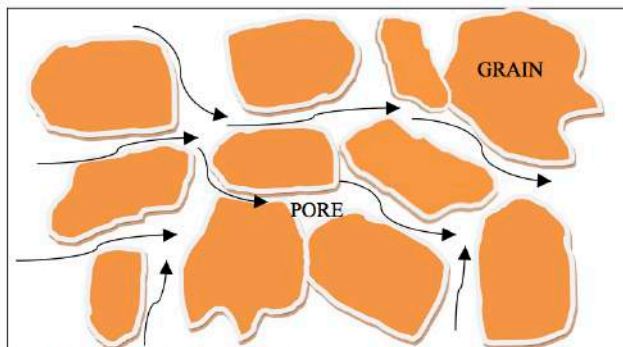


Fig 1 Flow through pores (spaces between grains)

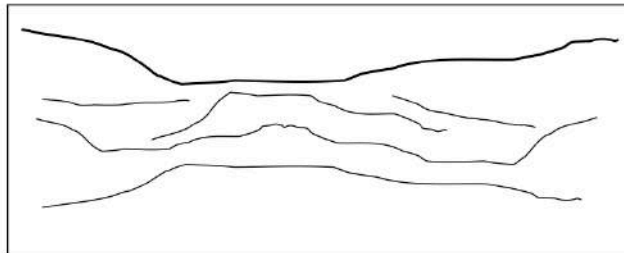


Fig 2 Flow through cracks (fractures) in rock

**Aquifer** - is a location under the ground that contains water which can be transmitted to a well. The material is usually sand or coarse grained deposits. In areas of rock, the path of water follows fractures or cavities in the rock.

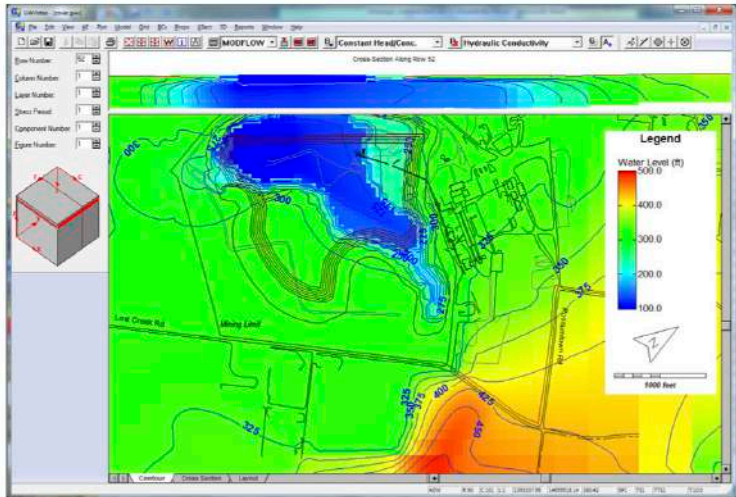
**Aquitard** - is a location under the ground that contains water, but this water **cannot** transmit the water easily to a well. This is usually finer-grained material like silt or clay.

The property that controls the flow of water in geological materials is called *hydraulic conductivity*, or *permeability*. We will learn more about this property in later sections.

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Tutorial Manual for  
**Groundwater Vistas**

Version 6



## Paper 6: Groundwater Vista exercise and tutorial

### Tutorial to Groundwater Vistas (MODFLOW MODEL)

CE 374L

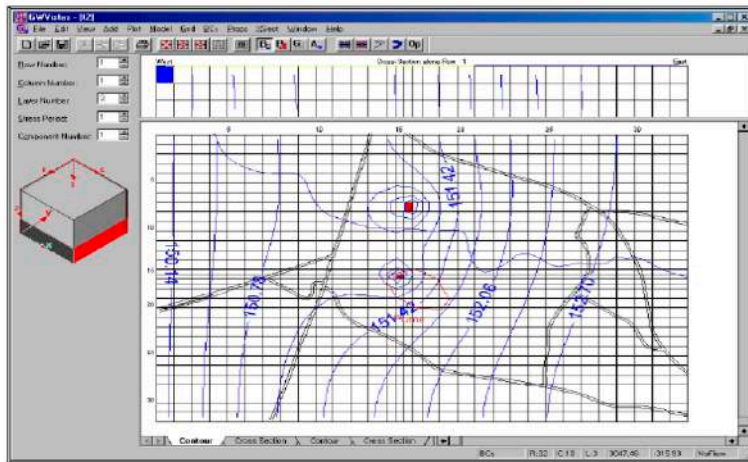
University of Texas at Austin

Prepared by Duajj AlRukaibi and Dr. Daene McKinney

Spring 2013

#### DESCRIPTION:

**G**roundwater Vistas (GV) is a powerful groundwater model design structure that has comprehensive graphical analysis tools for MODFLOW, and other models. GV shows the groundwater model design in both top and cross-sectional views using two windows. There are many ways to plot and present the Model using contours, shaded (color flood), velocity vectors, graph, and detailed mass balance analyses. In MODPATH, particle traces are also displayed in both top and cross-sectional views. GV provides particle tracking results before and after the process. MT3D can compute velocities (V) and flow rates (Q) into each cell. Another unique aspect of GV is designed to be a model-independent structure which where one only needs to learn one software program to be capable of use a variety of groundwater models. It can import maps and data from different software such as ArcGIS, AutoCAD, Surfer, and Hydraulic modeling. GV can accomplish four basic steps: Designing Models, Running Simulations, and finally Analyzing Results. GV has the ability to analyze operation performance in four different modes: Analytic Element, Grid, Property Zones, and Boundary condition.



Tutorial: GV application

1

### Application 1: Groundwater Vista Version 6, 32 bit

The application can be downloaded from <http://www.riversweb.org/monreCBP>.



## Module 5: Study Tour

### Program Agenda:

One Day Trip to Bann Aksang, IWMI's Groundwater Research Pilot

1. Village Office / Climate Station
  - Introductions, general talk about site, program of the day (Mathieu, Somphasith, Paul)
2. School Site (GW assessments in practice)
  - Continuous GW monitoring, aquifer testing, drilling of irrigation wells
3. Nadorn (GW irrigation in practice) – or somewhere else if weather doesn't allow show shallow dug well, deep tube well, agricultural practices (Coco, Mr Mon)
4. Lunch @ KM52
5. Domestic Supplies (visit 1 representative HH at Phousan village)
  - Demonstrate the source, highlight the quality, GW use survey of Vytou/Parn, garden-scale irrigation (Vytou, Jordan)



## V. Conclusions and Recommendations

As this was the first effort of its kind, some oversights were made and valuable experiences were gained that lead to suggestions for the next training session.

Overall, the intense pace of the course overwhelmed some students, so it is recommended that the number of days be increased with breaks occurring between changes in topics. For example, it would have been less demanding if it were a 20 day course that took place within a time span of 4 to 6 weeks.

The low yielding well was a result of a violation of a main tenet of groundwater work, namely that exploration, which includes geophysical surveying, be completed and analyzed before sighting a well, and this point was emphasized to the students and as such the poor well performance served as a significant lesson.

The pump test was conducted poorly, mainly due to the contractor's refusal to adjust the inline valve when the discharge started to decrease. The decreasing discharge is a violation of the analysis techniques required to assess the well. It is highly recommended that the Faculty of Water Resources purchase its own test pumping equipment, the cost of the pumps and accessory pumping being less than \$500.

As well as an increase in time, an increase in scope of works is also recommended. For example, the low discharge of the pump test and the nature of the aquifer precluded any drawdown response in the two closest existing wells, and thus an opportunity for further analysis, such as calculation of the storage coefficient, was not possible. For the next demonstration of borehole drilling, an observation well sited 10-20 meters away should be included in the scope of works. Another addition in the fieldwork could be a longer resistivity profile that would illustrate the practice of 'roll alongs' to increase the points that occur at greater depths. This is the practice of extending the profile by moving the resistivity line a predetermined spacing and starting from the beginning to have a longer continuous profile. Also, more areas of the Tad Thuong campus should be explored. Topographic survey work could also be more extensive.

All these suggestions have been incorporated into the Proposal for the next training session which is in Appendix I.

### **Basis for a Groundwater Training and Research Center**

Groundwater curriculum at NUOL in the past has been limited with few textbooks and resource materials and with no accommodation for any fieldwork. Before this training exercise, hardly any students have ever seen a drill rig, have never participated in a pumping test, nor are they familiar with geophysical surveying, leave alone water level mapping. Some efforts are currently being made at groundwater modeling, but it is not clear whether any of these models would be anything more than academic exercises with no relation to the situation in the field (mainly because of the paucity of valid data).

However, NUOL is now taking major steps in strengthening their curriculum and widening their experience with fieldwork. The current lack of expertise in groundwater threatens to hinder any rational development of this resource, and these efforts are being directed to address this problem.

Groundwater resources in just about all of Lao PDR have yet to be characterized. This is a major concern in the southern part of the country where water shortages occur regularly during the dry season and in karst areas where hydropower and mining activities threaten both quantity and quality. At the moment, there are at least six research projects being implemented by NUOL professors and students that are related to groundwater quantity and quality, and involving applications such as irrigated agriculture. In the past, there have been a few published papers on groundwater issues by NUOL staff. From this, we can conclude that the university does indeed have the capacity for research, but it is too small at the present time to play a major role in groundwater development. This capacity needs to be strengthened.

NUOL provides an academic environment, and the planning, organization, and successful completion of recent training activities, notably this one, has shown a great potential for further expansion in both training and research.





Having a central entity responsible for groundwater training and research would eliminate redundancy and facilitate coordination of research activities. Because groundwater studies are interdisciplinary by nature, it only makes sense to have the involvement of various faculties and departments, and a multi-disciplinary unit would be an effective way to cover all aspects of this vital resource. The roles of the training and research center are outlined below:

**Role as research entity:**

1. Repository/depository/library  
Accumulation and centralization of all information pertaining to groundwater
2. Central channel for all research activities in the country (coordination and facilitation)

3. Proposal writing for research grants
4. Public relations campaign - invitation to graduate schools and academic institutions to conduct theses and other research in Lao
5. Government - requires answers for strategic planning and policy

A **concept paper** serving as a **proposal** for the creation of a groundwater training and research center is currently in progress and expected be ready by the end of November 2015.

# **Training Manual for Collaborative Flood Modeling**





# I. Fact Sheet

Name of training course:	<b>Collaborative Flood Modeling</b>
Level and specialty:	Specialization
After the training, the trainees will:	<ol style="list-style-type: none"> <li>1. Have basic knowledge and capacities in understanding modeling purposes and appreciate how far it may help to better coordinate their water planning.</li> <li>2. Be able to prepare to consider requesting the use of modeling tools</li> <li>3. Refresh knowledge in basic hydrology and monitoring the components of the water balance</li> <li>4. Gain knowledge and practical skill on hydro-meteorological data treatment, and GIS tools for hydrology</li> <li>5. Gain knowledge and practical skill in HECRAS Application Model</li> </ol>
Target groups:	This training was specifically designed for targeted trainees, which are the prospective undergraduate and graduate students and lecturers from Faculty of Water Resources and Faculty of Science
Number of training days:	18 days
Dates and venue of training:	National University of Laos, Faculty of Water Resources, Thad Thong Campus
Number of trainees:	40 Trainees (15 women and 25 men)
List of trainees:	See Annex A-8
List of principal trainers:	<p>Assistant Professor Rachapat Ratanavaraha, Director of Water Resources Management Research Center, Kong Chi Mun River Basin, Rajamangala University of Technologies Isan, Thailand.</p> <p>Dr. Kowit Boonrawd, Assistant Dean, Faculty of Information Technology, Rajamangala University of Technologies Isan.</p> <p>Mr. Songphol Songsaengrit, Assistant Lecturer, Rajamangala University of Technologies Isan.</p>
Training methodologies:	<p>The training was divided into six different modules which exploited different methodologies in class work and virtual exercises that include</p> <p>Module 1: Basic hydrology and Hydrological system of Xaybangfai (1.5 days)</p> <p>Module 2: Basic Global Climate Model, and local Xaybangfai climate models, Lower Mekong Basin and Xaybangfai (0.5 day) &amp; Satellite Model Application (0.5 day)</p> <p>Module 3: Database and ARC and Quantum GIS (3 days)</p> <p>Module 4: Application of HECRAS Model (15 days)</p>

Training materials:	<ol style="list-style-type: none"> <li>1. Situation Analysis, Training Concept and Training Modules</li> <li>2. Training Program Agenda with Training Methodologies</li> <li>3. Keynote Presentations</li> <li>4. Application Software in HECRAS and GIS</li> </ol>
Recommended additional reference materials:	N/A
Training assessment results and findings:	<p>The training was highly successful and all the trainees enjoyed the gained skill built in HECRAS Flood Model and how they can be participatory used with different types of stakeholders. The training was evaluated and gave average score at 9 out of 10. A team of young professional flood modelers was built from this training. Everyone expressed that they were excitedly looking forward to attending the next advance training course and field trip.</p>
Next steps and Recommendations:	<p>Unfortunately, that the next series of the training did not happen under the timeline of this TA. It is suggested that the training should be continuing and implement the field work in Xaybangfai Basin. The trainees would be required to collect further inputs and data, and consult their draft model results with local communities and stakeholders who have suffered from the floods. Based on further data inputs and new tested run models, the trainees would also be assigned to propose for possible solutions on flood risks management either in non-infrastructure and infrastructure approaches for Xaybangfai.</p>



## II. Situation Analysis, Training Concepts and Training Modules

### A. Justification

The objective is to train a group of NUOL student at both undergraduate and master's degree level in collaborative modeling in water resources management. The Collaborative Modeling Training is implemented in series. The first training aims to present (or refresh) the knowledge on basic hydrology, to provide an understanding of different hydro-meteorological parameters used in the models and how to collect data and monitor these parameters. The following training then aims to provide understand on how to manage and maintain hydro-meteorological data, how to use GIS as a tool for hydrology, and how to use different hydrological models as decision tools for specific river basin management issues. The issues that the trainees would work on will be the issues identified during the field visit from the discussion with the stakeholders.

### B. Summary of the Training Module

The training would consist of 1 field visit and 5 modules:

- **Field Visit:** including meeting with stakeholders (the field visit was organized as part as another training organized for NIWRMSP under Component 1)
- **Module 1:** Basic Hydrology
- **Module 2:** Hydro-meteorological Data Collection
- **Module 3:** GIS Application on Hydrology and Modeling Preparation
- **Module 4:** HECRAS Modeling Tools for Water Resources Management

### C. Detailed Topics Covered by the Modules

#### Field Visit and meeting with stakeholders

The objective for the field visit is to organize meetings with various stakeholders in the targeted area, i.e. Xaybongfai basin under this training. The discussion with the stakeholders would allow the trainees to gain a better understanding of the actual basins issues. The identified issues would be used as "case studies" under this training. These case studies would serve as real-world practical examples for the trainees to apply the theories that they have learned during this training series.

The field visit is also included as part of the training to best reflect the situation in which the hydrological models can be used. As the training is built on the concept of collaborative modeling, this suggests that the model will be used a tool to present the issues with references to the situation presented by the stakeholders to facilitate the water dialogue. Therefore, in actual application, the modelers will have to gather the information from the stakeholders and treat the stakeholders as "the Client".

#### Module 1: Basic Concept of Hydrology

##### 1. Hydrological Cycle:

- i. The global hydrologic cycle: transfers of water between the land, ocean and atmosphere, and;
- ii. The land phase of the hydrologic cycle: the movement of water on and under the land surface (quantity and quality).

##### 2. Why study hydrology?:

Human systems are intimately shaped by the availability of water, flows pattern and quality of water e.g. Agriculture, drinking water, hydropower, industry, recreation, etc.

##### 3. The Hydrological Concept of Watersheds and River Basins:

- i. Definitions;
- ii. Digital Elevation Model (DEM) and methods watersheds delineation and streams burning;
- iii. Why it is generally recommended that water management be linked with the concept of river basins and watersheds limits?

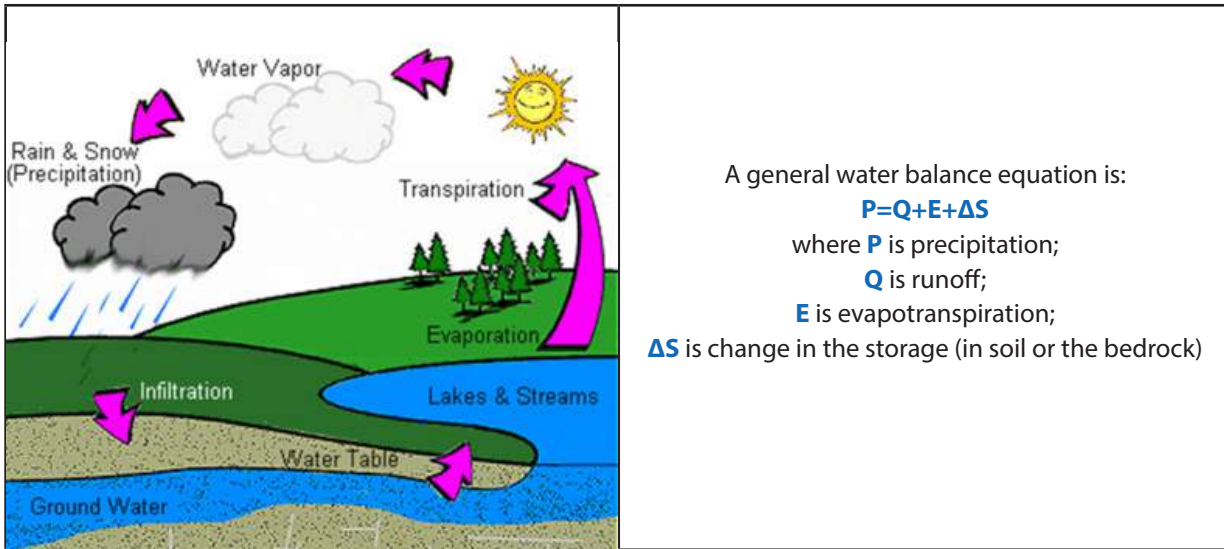
##### 4. The Water Balance:

- i. Relation (equation) between rainfall, infiltration, runoff, evaporation, groundwater storage and base flow;
- ii. Dimensions and units, and;
- iii. Parameters that may modify this balance (impacts of human activities on water balance).

##### 5. An Example of the Use of Hydrology:

The rainfall-runoff relation – the parameters that impact this relationship and the consequences for flood management.

**Figure 24: The Water Balance and Relation Equation**



**Figure 25: Hydro-meteorological Parameters in Relation to Water Balance and Units of Measurements**

This figure is a grid of images illustrating hydro-meteorological parameters and measurement methods. The top-left panel shows a diagram of the water cycle with red boxes highlighting 'Rainfall', 'Evaporation-Transpiration', 'Groundwater', 'Runoff', and 'Base flow'. The top-right panel shows the same diagram with red boxes highlighting measurement methods: 'Rain gauge', 'Evaporation Pan', 'Automatic Weather Station', 'Flow Meter', 'Staff Gauges', and 'Groundwater monitoring'. The bottom-left panel shows a photograph of a stream with a vertical scale (ruler) and a diagram of a stream cross-section with 'Maximum Water Level' indicated. The bottom-right panel shows a photograph of a stream with a blue sign for 'กรมชลประทาน' (Department of Water Resources Development and Administration) and a photograph of a flow meter.



## Module 2: Knowledge and Data Collection – Hydro-Met Equipment

**1. Review of the hydro-meteorological parameters** that must be monitored, according to the water balance equation; frequency of measurement, units.

### 2. Hydro-meteorological Sensors:

- i. Rain gauge, e.g. simple rain gauge, tipping bucket, etc.;
- ii. Water level, e.g. staff gauge, pressure, bubble, float system; meteorological station (i.e. the parameters for the evaluation of the evaporation), e.g. wind direction and velocity, solar radiation, atmospheric pressure, temperature, evaporation pan, etc.;
- iii. Groundwater observation, and;
- iv. Where to install the stations in a river basin according to the potential identified issues.

### 3. Measuring the Discharge in the Rivers:

- i. The calibration curve: Water Level versus Discharge;
- ii. The Manning equation;
- iii. Range of equipment for measuring discharge in a river, and;
- iv. Statistical treatment of the points measured in the field to sort out the calibration curve.

### 4. Data Observation:

- i. Manual reading, electronic data storage, data tele-transmission;
- ii. Data for statistical purpose and data for nearly-real time forecasting;
- iii. Quick field quality control, and;
- iv. Operation and maintenance: key issues and recommendations.

### 5. How to store the hydro-meteorological data:

- i. Handwritten form;
- ii. Excel file;
- iii. Dedicated hydrological database, and;

iv. What kind of data treatment/maintenance that modelers need.

### 6. Brief Introduction to the Hydrological Database HEC-DSS<sup>13</sup> (Open Source):

The U.S. Army Corps of Engineers' Hydrologic Engineering Center Data Storage System, or HEC-DSS, is a database system designed to efficiently store and retrieve scientific data that is typically sequential. Such data types include, but are not limited to, time series data, curve data, spatial-oriented gridded data, and others. The system was designed to make it easy for users and application programs to retrieve and store data. HEC-DSS is incorporated into most of HEC's major application programs.

## Module 3: Basic of GIS Application for Hydrology

### 1. Vector Layers and Raster Layers:

Concept of layers, basic treatment of layers, projections (mainly 2 systems: spherical WGS 1984 and WGS 1984-UTM 48N): to be developed on QGIS<sup>14</sup> - QGIS is an open-source (free license) software that offers similar features as Arc GIS with same format (.shp). It is regularly updated and may be easily disseminated to a large number of users.

### 2. Introducing Digital Elevation Model from ASTER-GTM2<sup>15</sup> or STRM<sup>16</sup>:

- i. Downloading images from the website, and;
- ii. Calculating contour and getting relief raster (with QGIS).

### 3. Watershed Delineation: (To be developed on MapWindow<sup>17</sup>)

Map Window is likely the only open-source software (free license) that offers a powerful function for watersheds and stream delineation.

### 4. Exercise:

Watershed and streams delineation for Sebangfai river basin.

13. <http://www.hec.usace.army.mil/software/hec-dss>

14. <http://www.qgis.org/en/site>

15. [The Advanced Spaceborne Thermal Emission and Reflection Radiometer \(ASTER\) Global Digital Elevation Model \(GDEM\) - ASTER GDEM is a product of METI and NASA: http://asterweb.jpl.nasa.gov/gdem.asp](http://asterweb.jpl.nasa.gov/gdem.asp)

16. The SRTM 90m DEM's have a resolution of 90m at the equator, and are provided in mosaiced 5 deg x 5 deg tiles for easy download and use. All are produced from a seamless dataset to allow easy mosaicing. These are available in both ArcInfo ASCII and GeoTiff format to facilitate their ease of use in a variety of image processing and GIS applications. (<http://srtm.csi.cgiar.org/>)

17. <http://www.mapwindow.org> (MapWindow has also a plugin for developing the model SWAT)

Figure 26: Vector Layers and Raster Layers

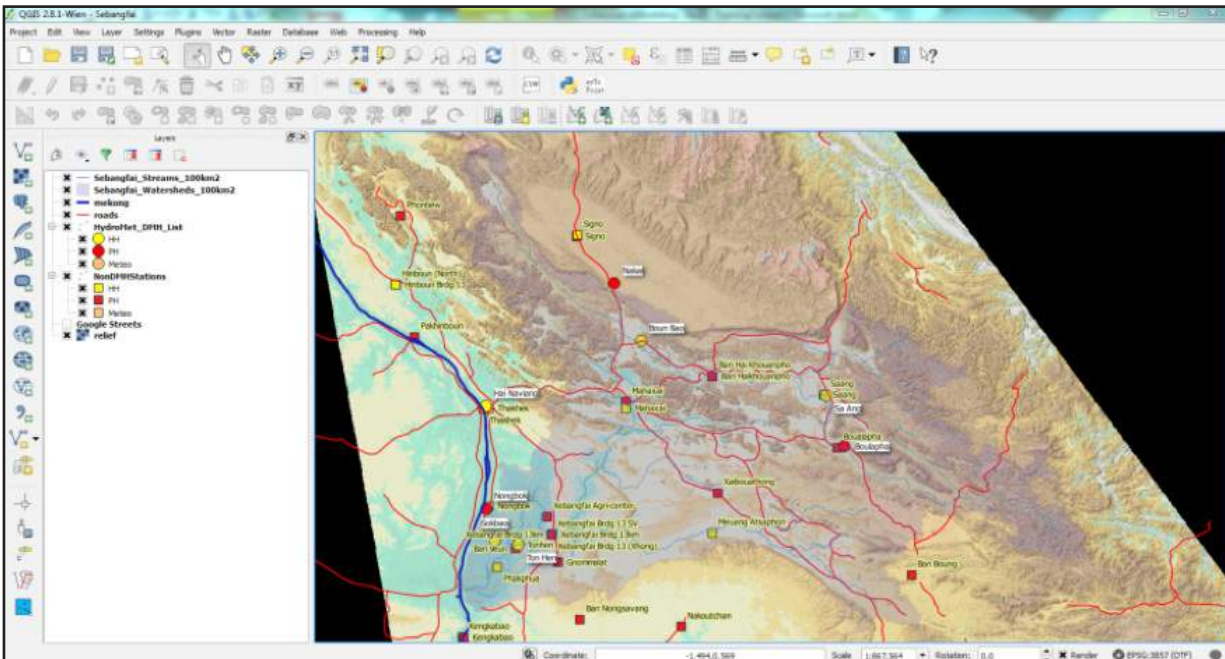
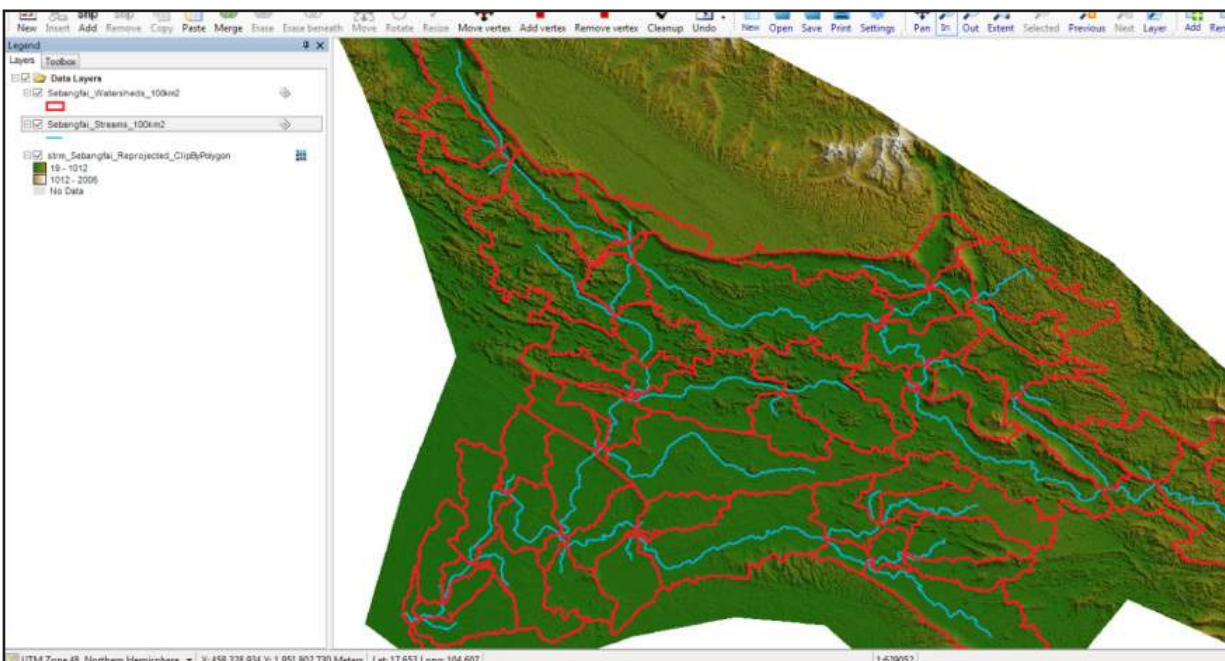


Figure 27: Example of Watershed Delineation



## Module 4: Introduction to Modeling Tools Applied to Help Tackle Issues in River Basin Management

### 1. Overview of the Modeling Tools:

- i. Deterministic models and statistical models, and;
- ii. Establish a table of issues discussed with the stakeholders in Xaybangfai basin and the potential models that may help tackling these issues.

### 2. Hydrological Model: (The Rainfall-Runoff Relation)

- i. Rational method as a basic model;
- ii. HEC-HMS<sup>18</sup> as a sophisticated model for complex basins. The Hydrologic Modeling System (HEC-HMS) is designed to simulate the complete hydrologic processes of dendritic watershed systems. The software includes many traditional hydrologic analysis procedures such as event infiltration, unit hydrographs, and hydrologic routing. HEC-HMS also includes procedures necessary for continuous simulation including evapotranspiration, snowmelt, and soil moisture accounting, and;
- iii. Discussion about the limit of the use of simple models or sophisticated ones; the model calibration issues.

### 3. Cascade of Dams:

The importance of coordination of the management of a cascade of dams to ensure all benefits/costs

are considered (e.g. electricity production; flood management, irrigation, environmental flow), including short introduction to HEC-ResSim<sup>19</sup> model.

The Reservoir System Simulation (HEC-ResSim) software developed by the U.S. Army Corps of Engineers, is used to model reservoir operations at one or more reservoirs for a variety of operational goals and constraints. The software simulates reservoir operations for flood management, low flow augmentation and water supply for planning studies, detailed reservoir regulation plan investigations, and real-time decision support.

### 4. Hydraulic Model:

- i. The natural river channel and the impact on infrastructures on flows and water levels;

Short introduction to HEC-RAS<sup>20</sup> model. HEC-RAS allows to perform one-dimensional steady flow, unsteady flow, sediment transport/mobile bed computations, and water temperature modeling.

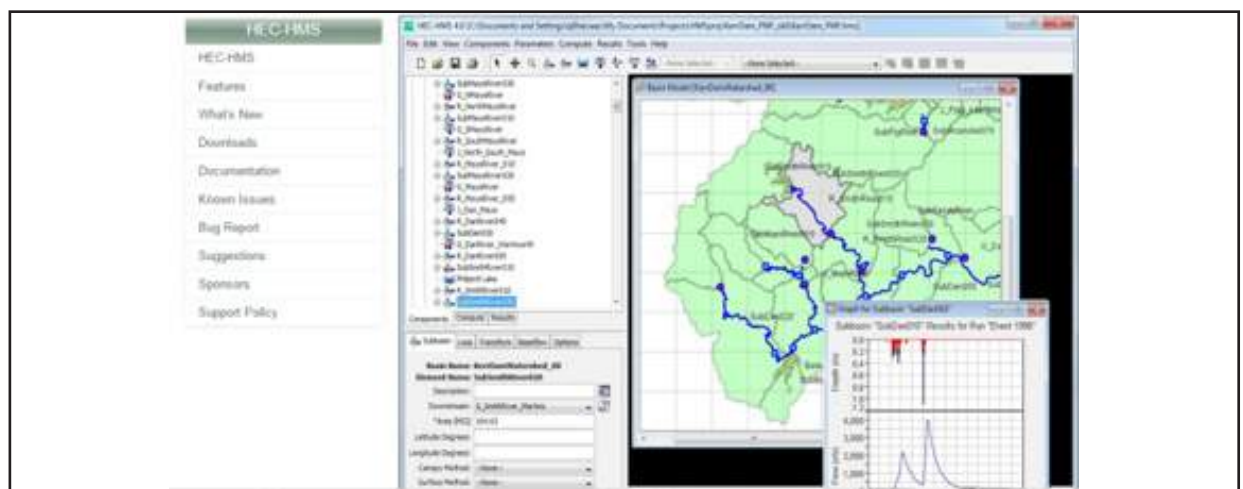
### 5. Water Budget and Water Quality Management:

- i. Managing the water dialogue, and;
- ii. Introduction to Decision Support modeling.

### 6. Exercise:

Develop HEC-HMS applied to the relation rainfall-runoff in Xaybangfai River.

Figure 28: Example of HEC-HMS Model



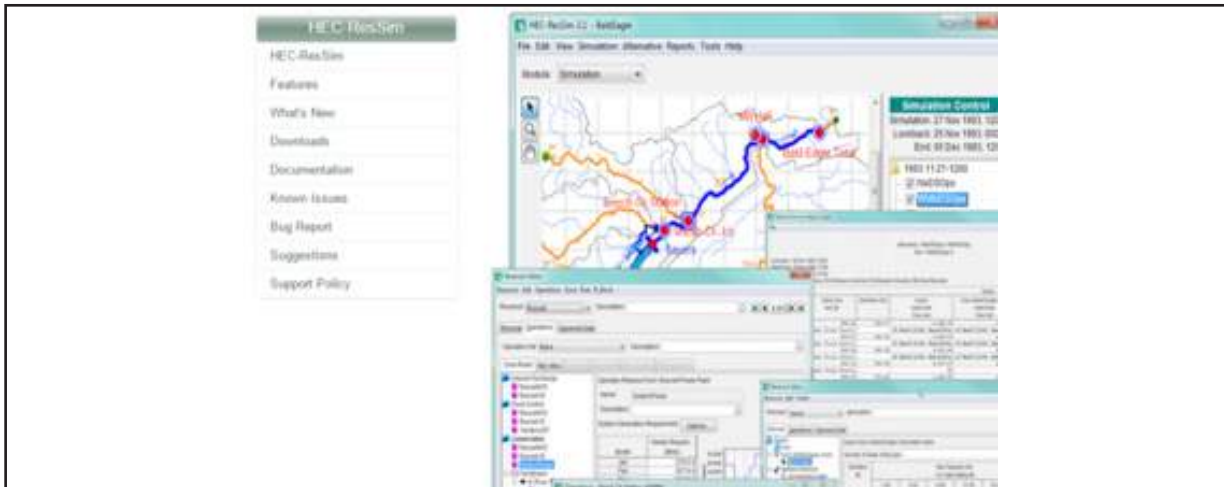
18. <http://www.hec.usace.army.mil/software/hec-hms>

19. <http://www.hec.usace.army.mil/software/hec-ressim>

20. <http://www.hec.usace.army.mil/software/hec-hms>



**Figure 29: Example of HEC-ResSim Model**



### D. Time Table

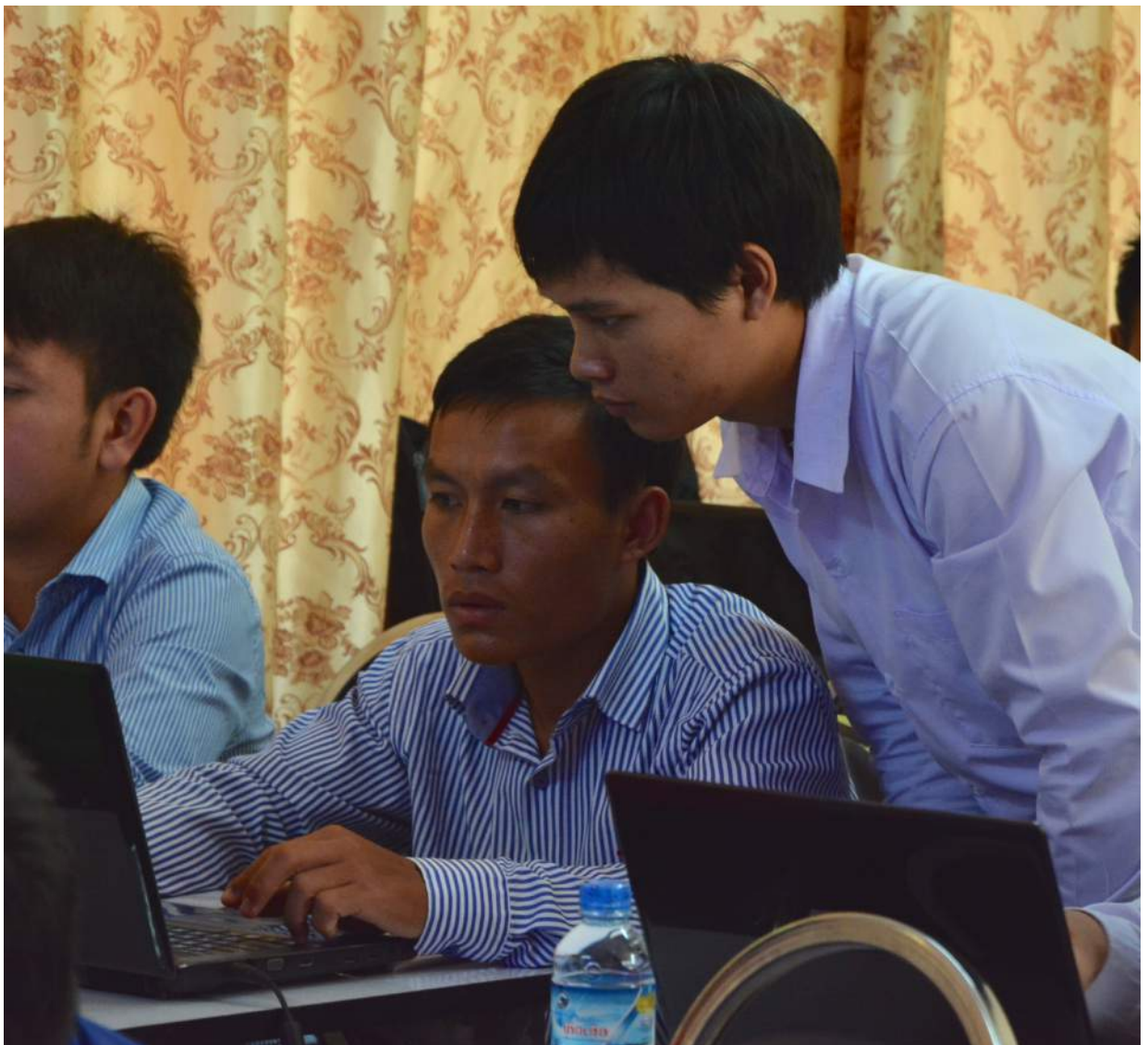
Module	Sub-module	Days	Trainers
<b>Module 1</b>	(5 topics)	1,5	Assistant Professor Rachapat Ratanavaraha, Director of Water Resources Management Research Center, Kong Chi Mun River Basin, Rajamangala University of Technologies Isan, Thailand
<b>Module 2</b>	(6 topics)	1,5	
<b>Module 3</b>	(4 topics including exercise)	3	
<b>Module 4</b>	(6 topics including exercise)	12	
TOTAL		18	





## III. Training Program Agenda

- Day 1:** Basic hydrology
- Day 2-3:** Hydrological system of Xaybangfai,  
Basic Global Climate Model, and local Xaybangfai climate models,  
Lower Mekong Basin and Xaybangfai  
And Satellite Model Application:
- Day 4-6:** Database and ARC and Quantum GIS (3 days)
- Day 7-18:** Application of HECRAS Model (6 days)



# IV. Training Materials

## Keynote presentation 1: Introduction to Hydrology and Hydrological Model (Thai)

### Modeling tools for water resources management.



**Modeling tools for water resources management.**

**Basic of Hydraulic Model:**  
การไหลในทางน้ำเปิด (Open Channel Flow)

ทางน้ำธรรมชาติ  
Natural channel

Main channel  
Flood plane

ทางน้ำที่มนุษย์สร้างขึ้น  
Artificial channel

**Modeling tools for water resources management.**

การจำแนกประเภทการไหลในทางน้ำเปิด  
(Open channel flow classification)  
พิจารณาการเปลี่ยนแปลงกับเวลาเวลา

a) การไหลคงที่ (Steady flow)  
คือการไหลที่ไม่มีการเปลี่ยนแปลงตามเวลา กล่าวคือตัวแปรต่างๆ ที่เกี่ยวข้องกับการไหล เช่น ความลึก (y) ความเร็ว (V) อัตราการไหล (Q) พื้นที่หน้าตัดการไหล (A) จะคงที่ตลอดช่วงเวลาที่จะพิจารณา

$$\frac{dy, Av, Q}{dt} = 0$$

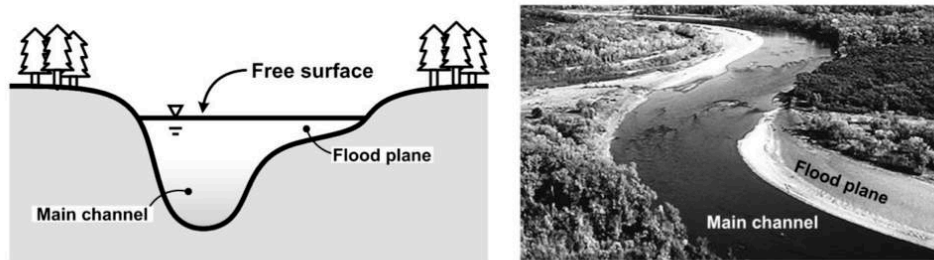
b) การไหลไม่คงที่ (Unsteady flow)  
คือการไหลที่มีการเปลี่ยนแปลงตามเวลา กล่าวคือตัวแปรต่างๆ ที่เกี่ยวข้องกับการไหล เช่น ความลึก ความเร็ว อัตราการไหล พื้นที่หน้าตัดการไหล ไม่คงที่ตลอดช่วงเวลาที่จะพิจารณา

$$\frac{dy, Av, Q}{dt} \neq 0$$

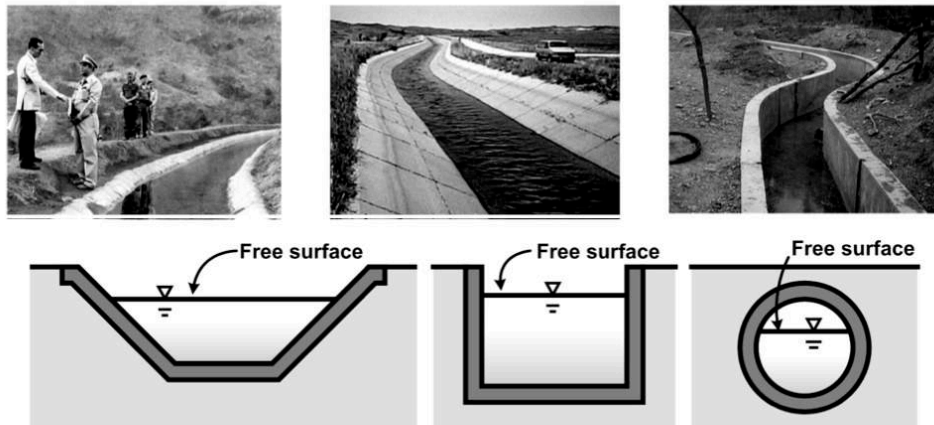
## Basic of Hydraulic Model:

### การไหลในทางน้ำเปิด (Open Channel Flow)

การไหลในทางน้ำเปิดจะมีผิวน้ำอิสระที่สัมผัสกับอากาศ (Free Surface) และมีความดันเท่ากับความดันบรรยากาศ การไหลในทางน้ำเปิดที่พบเห็นได้บ่อย ๆ ได้แก่ การไหลของน้ำในแม่น้ำ ลำคลอง ทางน้ำตามธรรมชาติ หรือแม้แต่การไหลในร่องน้ำที่มนุษย์สร้างขึ้น ได้แก่ คลองส่งน้ำเพื่อการชลประทาน ทางระบายน้ำลอดใต้สะพาน ท่อระบายน้ำลอดถนน เป็นต้น ตัวแปรที่สำคัญที่มีผลต่อการไหลของน้ำในทางน้ำเปิดก็คือ รูปร่างและขนาดของพื้นที่หน้าตัดของการไหล ความลาดเอียงของท้องน้ำ สัมประสิทธิ์ความขรุขระของพื้นผิวทางน้ำเปิด ความเร็วของการไหล และอัตราการไหลของน้ำ อย่างไรก็ตาม การศึกษาการไหลในทางน้ำเปิดธรรมชาติทำได้ยาก และไม่สะดวก จึงนิยมทำการศึกษาและทดลองในห้องปฏิบัติการโดยใช้เครื่องมือที่เรียกว่า Variable-slope flume เป็นรางน้ำเปิดจำลองซึ่งผลจากการศึกษาสามารถนำไปประยุกต์ใช้ได้กับการไหลในทางน้ำเปิดธรรมชาติได้



รูปที่ 1 ทางน้ำธรรมชาติ



รูปที่ 2 ทางน้ำที่มนุษย์สร้างขึ้น



## Keynote presentation 2: Hydrological System in Xaybangfai (English)

Cambodia • Lao PDR • Thailand • Viet Nam  
For sustainable development

**HEC-RAS Model :**  
Collaborative Modeling Training and stakeholder engagement in Xebangfai.  
กรณีศึกษา : ลุ่มน้ำสาขา Xebangfai River

**Assistant Professor Rachaphat Ratanavaraha**  
DIRECTOR OF WATER RESOURCES MANAGEMENT RESEARCH CENTER:  
KONG - CHI - MUN RIVER BASIN :  
TNMC :Thailand : CCAI : IKMP : BDP : EP :FP: MRC  
Rajamangala University of Technology Isan - RMUTI

[www.mrcmekong.org](http://www.mrcmekong.org)

### Nam Theun 2

The Nam Theun 2 Hydropower Project, or simply NT2, is a [hydroelectric dam](#) located on the [Nam Theun River](#) in [Laos](#). Commercial operation of the plant began in March 2010. The scheme diverts water from the Nam Theun, a [tributary](#) of the [Mekong River](#), to the [Xe Bang Fai River](#), enabling a generation capacity of 1,070 [MW](#), from a 350 m (1,148 ft) difference in elevation between the [reservoir](#) and the [power station](#).

[www.mrcmekong.org](http://www.mrcmekong.org)

### The Project....

Figure 1 – Nam Theun 2 Locality Plan

[www.mrcmekong.org](http://www.mrcmekong.org)



Keynote presentation 3: Hydrological System in Huay Xaybath, a Case Study (Thai)

**การจัดการทรัพยากรน้ำ**  
**ในเขตลุ่มน้ำสาขา ห้วยสายบาตร**  
**(รหัสลุ่มน้ำสาขา 0415)**  
**WATER RESOURCES MANAGEMENT IN THE WATERSHED AREA CHI RIVER BRANCH HUAI SAY BAT**

**การนำเสนอปริญญาโท**  
**ประกอบรายวิชาโครงการ (Project)**  
 เรื่อง การบริหารจัดการทรัพยากรน้ำในพื้นที่ลุ่มน้ำสาขาห้วยสายบาตร (รหัสลุ่มน้ำสาขา 0415)  
**WATER RESOURCES MANAGEMENT IN THE WATERSHED AREA CHI RIVER BRANCH HUAI SAY BAT**  
 จัดทำโดย  
 นายทวีศักดิ์ พรหมภักดี  
 นายสุรพงษ์ เอี่ยมวิจิตร  
 นายณัฏวัฒน์ ทักนิณบุตร  
 อาจารย์ที่ปรึกษา ผศ.ราชภัทร รัตนวราห

**ความสำคัญ**

ไม่สามารถช่วยเหลือประชาชน และสนองความต้องการน้ำเพื่อการพัฒนาต่างๆ ได้ทั่วถึง

ทำให้ประสบปัญหาเกี่ยวกับการขาดแคลนน้ำ หรือความเดือดร้อนในเรื่องน้ำที่นับวันจะทวีความรุนแรงมากขึ้นเรื่อยๆ

นำไปเป็นกรอบและมอบหมายให้หน่วยปฏิบัติที่ดำเนินงานเกี่ยวกับการจัดการทรัพยากรน้ำนำไปปฏิบัติตามภาระหน้าที่อย่างเป็นระบบและเป็นไปในทิศทางเดียวกัน

ที่มา : [www.google.co.th/search?q=ลุ่มน้ำซี](http://www.google.co.th/search?q=ลุ่มน้ำซี)

## Short video 1: Introduction of WM Application, a Weather Forecasting Application (Thai)





## Keynote presentation 4: GIS Introduction (Thai)

**ระบบสารสนเทศภูมิศาสตร์  
(GIS)**

อาจารย์ทรงพล ทรงแสงฤทธิ  
สาขาวิชาวิศวกรรมโยธา คณะวิศวกรรมศาสตร์  
มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน วิทยาเขตขอนแก่น

**ความเป็นมาของ GIS**

ความเป็นมาของ GIS

**อดีต** → 

**แผนที่กระดาษ (Paper Map)**

ข้อจำกัด เช่น

- ข้อมูลอาจจะถูกย่อหรือลดปริมาณข้อมูลลง ทำให้รายละเอียดบางอย่างถูกกรองออกไป
- กรณีพื้นที่มีขนาดใหญ่ มีปริมาณข้อมูลมาก จนต้องแสดงแผนที่หลายฉบับ อาจเกิดรายละเอียดตรงรอยเชื่อมต่อระหว่างแผนที่สูญหายได้
- การเก็บรวบรวมข้อมูล การประมวลผลข้อมูล และการผลิตแผนที่ **ใช้เวลาและสิ้นเปลืองค่าใช้จ่ายมาก** ซึ่งไม่เหมาะสมต่อการนำไปใช้ประโยชน์ในเรื่องที่ต้องการข้อมูลเชิงพื้นที่ที่มีความทันสมัยอยู่เสมอ

อ.ทรงพล ทรงแสงฤทธิ      ม.ราชภัฏนครราชสีมา

**ความเป็นมาของ GIS**

**ปัจจุบัน** → 

**เทคโนโลยี GIS**

สำหรับในประเทศไทยเองก็มีการใช้งาน GIS หลายหน่วยงาน ทั้งหน่วยงานราชการ สถาบันการศึกษา และหน่วยงานเอกชนต่างๆ

  
เกษตร

  
ภัยพิบัติ

  
การใช้ที่ดิน

  
ทรัพยากรและสิ่งแวดล้อม

อ.ทรงพล ทรงแสงฤทธิ      ม.ราชภัฏนครราชสีมา

## การกำหนดตำแหน่ง (Position)

- ระบบพิกัดภูมิศาสตร์
- ระบบพิกัด UTM

## ความสูงและทรวดทรง (Elevation and Relief)

### รูปทรงรี (Spheroid or Ellipsoid)

บอกให้ทราบว่าแผนที่นี้ใช้รูปทรงรีอะไร ในการทำแผนที่ ซึ่งในอดีต แต่ละภูมิภาคของโลกจะใช้รูปทรงรีที่ต่างกันเช่น ทวีปอเมริกาเหนือ ใช้ Clarke Ellipsoid ปี ค.ศ. 1866 ส่วนประเทศไทยใช้ Everest Ellipsoid

เพื่อความสะดวกต่อการพิจารณารูปทรงพื้นฐานของโลก และในกิจการของแผนที่ จึงมีการใช้รูปทรงพื้นฐานของโลกอยู่ 3 แบบ คือทรงกลม (Sphere) ยีออยด์ (Geoid) และทรงรี (Spheroid หรือ Ellipsoid)

ทรงกลม หรือ สเฟีย (Sphere) เป็นรูปทรงที่ง่ายที่สุด จึงเหมาะเป็นพื้นฐานของโลกโดยประมาณ ใช้กับแผนที่มาตราส่วนเล็กที่มีขอบเขตกว้างขวาง เช่น แผนที่โลก แผนที่ทวีป หรือ แผนที่อื่นๆที่ไม่ต้องการความละเอียดถูกต้องสูง

### รูปทรงรี (Spheroid or Ellipsoid)

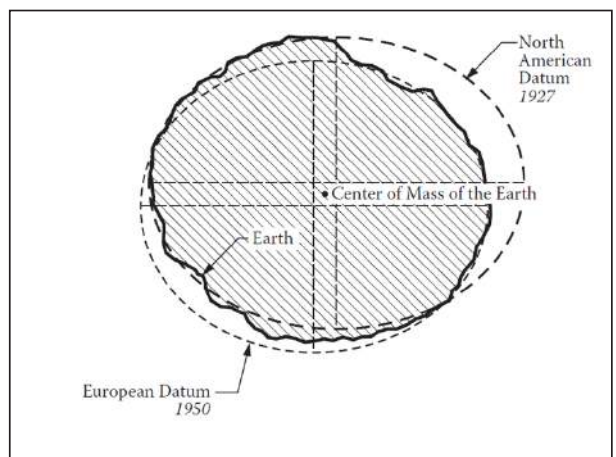
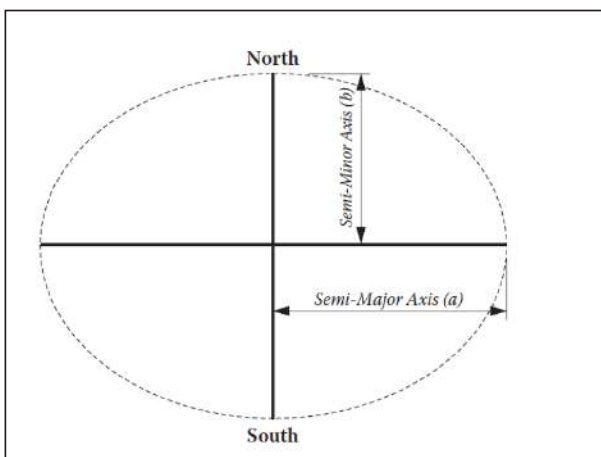
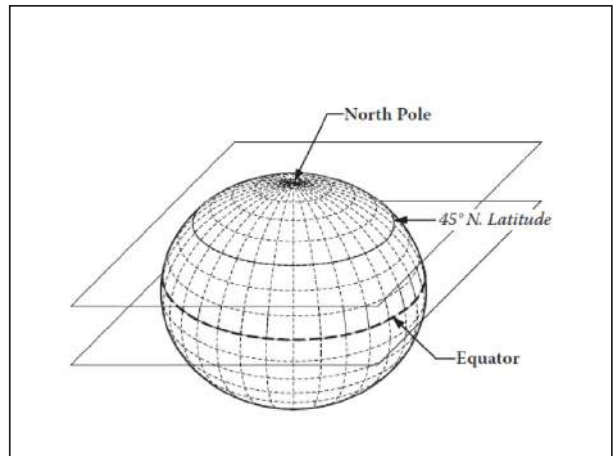
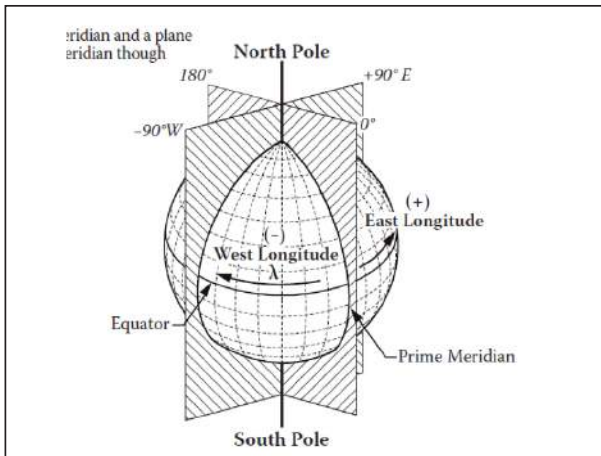
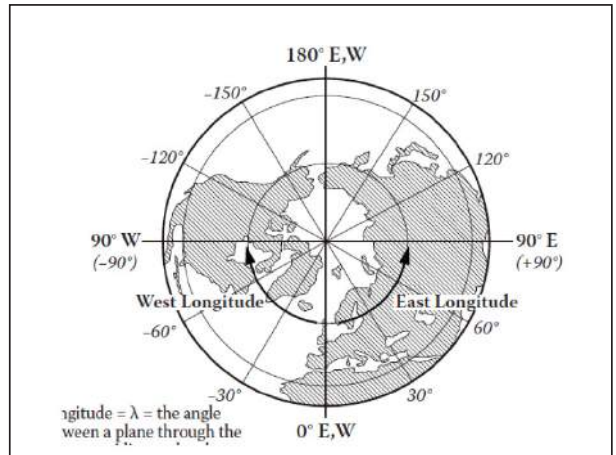
ยีออยด์ (Geoid) เป็นรูปทรงที่เหมือนกับสัณฐานจริงของโลกมากที่สุดเกิดจากการสมมติระดับน้ำในมหาสมุทรขณะทรงตัวอยู่นิ่ง เชื่อมโยงให้ทะลุไปถึงกับทั่วโลก จะเกิดเป็นพื้นผิวซึ่งไม่ราบเรียบตลอด มีบางส่วนที่ยุบต่ำลง บางส่วนสูงชันขึ้นอยู่กับความหนาแน่นและแรงโน้มถ่วงของโลก





# Keynote presentation 6: Development of Coordinate System (Thai)

## Basic GIS Coordinates



# Keynote presentation 7: Introduction to ArcGIS (Thai)

โปรแกรมระบบสารสนเทศภูมิศาสตร์

## GIS Software

โปรแกรมระบบสารสนเทศภูมิศาสตร์

**1. แบบมีลิขสิทธิ์**


- ArcGIS
- MapInfo
- Geomedia
- Idrisi
- ฯลฯ

**2. แบบรหัสเปิด**

- Quantum GIS
- MapWindow GIS
- ILWIS
- GRASS GIS
- ฯลฯ


**1. Quantum GIS**

- <http://www.qgis.org/>
- ประเภทออนไลน์
- มีหน้าต่างโปรแกรมคล้าย ArcGIS ใช้งานง่าย
- รองรับใช้งานทั้งข้อมูล Raster และ Vector
- มีทั้ง ข้อมูล Shape file format MI
- สามารถเชื่อมต่อกับ GRASS ได้



**2. MapWindow GIS**

- <http://www.mapwindow.org/index.php>
- วัตถุประสงค์เพื่อเชื่อมโยงพื้นที่
- ใช้งานได้ง่ายขนาดของโปรแกรมเล็ก
- มีฟังก์ชันค่อนข้างหลากหลาย
- สามารถรองรับ shape file
- มี plug in เฉพาะทาง



**3. ILWIS**

- <http://www.ilwis.org/>
- พัฒนามาจาก ITC
- จุดเด่นของ ILWIS เน้น เรื่องของ Geostat
- สามารถทำงานได้ทั้ง Raster และ Vector

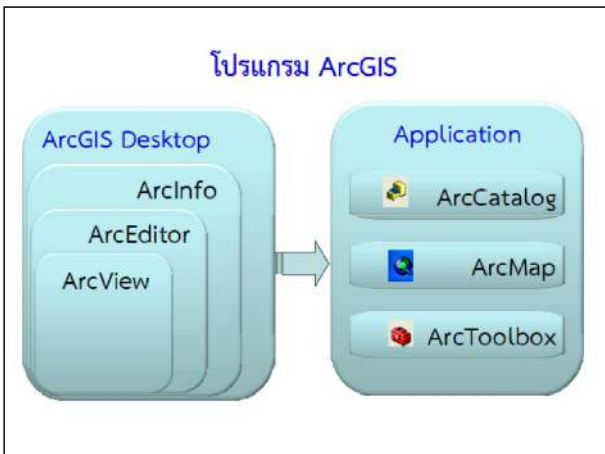


**4. GRASS GIS**

- <http://grass.itc.it/>
- ประเทศสหรัฐอเมริกา
- จัดการข้อมูล ประมวลผลข้อมูลที่เกี่ยวข้องกับข้อมูลไมโทเจนซิง




ArcGIS® ArcMap™  
10.1  
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esri  
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# Keynote presentation 8: GIS Map Development (Thai)

## การสร้างแผนที่

### แนวความคิดในการออกแบบแผนที่

เราสร้างและออกแบบแผนที่เพื่ออะไร ?

การถ่ายทอดแนวความคิด ความรู้ หรือข่าวสารข้อมูล  
จากบุคคลหนึ่งไปสู่บุคคลหนึ่งเพื่อให้เกิดความเข้าใจที่ตรงกัน

### แนวความคิดในการออกแบบแผนที่

**การสื่อสาร**

**ภาษา** ผ่านการพูดและการเขียน

**ภาพ** ผ่านแผนที่และสัญลักษณ์ต่างๆ  
เป็นการสื่อสารที่ผู้รับสารต้องรับรู้ด้วยตา  
(Visual Communication)

### How do I say what to whom

I = Cartographer  
To whom = Map user  
The map = How  
Subject = What

### แนวความคิดในการออกแบบแผนที่

**ข้อดีของการใช้แผนที่ในการสื่อสาร**

สามารถบรรยายลักษณะเชิงพื้นที่ต่างๆ ได้เข้าใจมากขึ้น

**“A map is worth a thousand word”**

แผนที่แผ่นเดียวสามารถแทนค่าได้หลายร้อยพันคำ

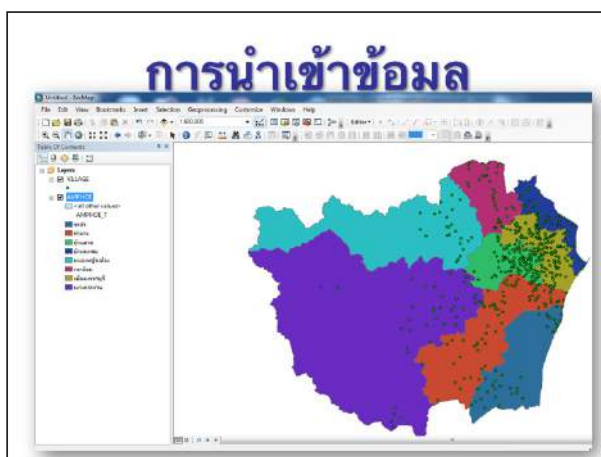
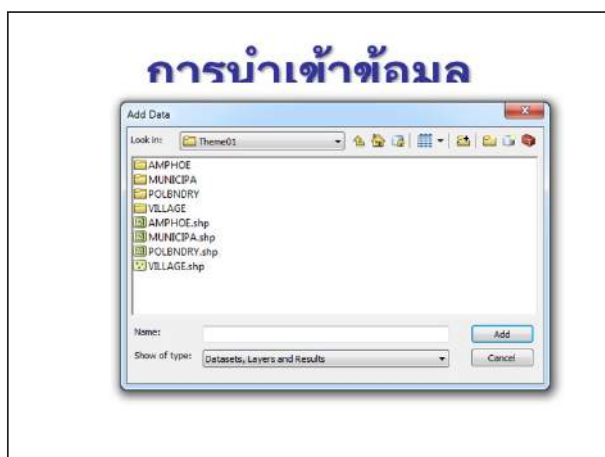
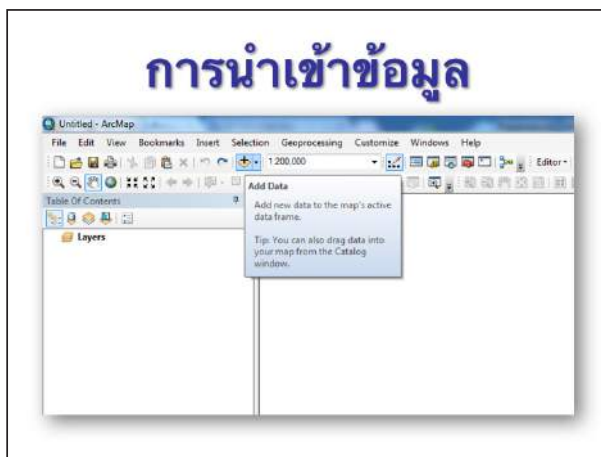
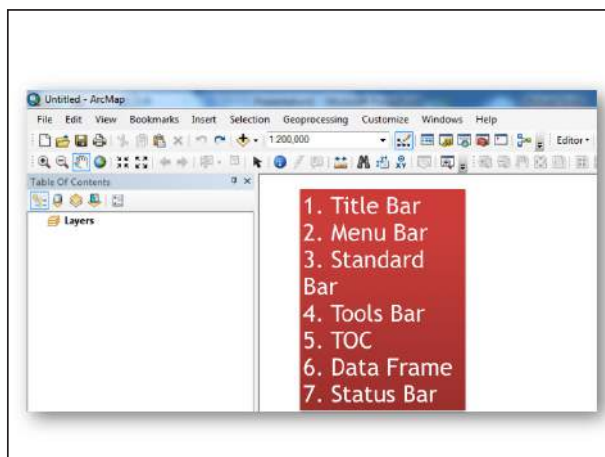
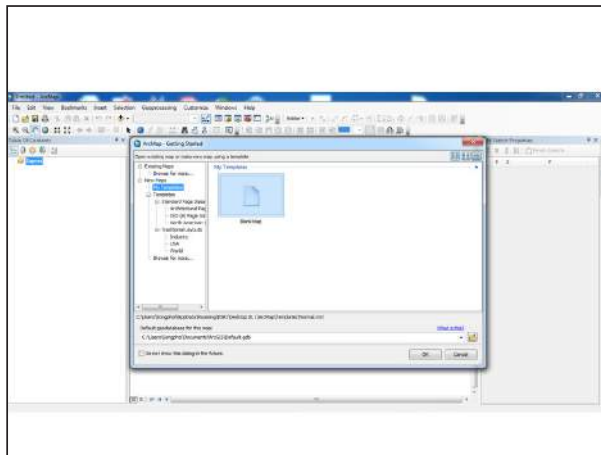
### ประเภทของแผนที่และความแตกต่างของแผนที่แต่ละประเภท

โดยทั่วไปแบ่งแผนที่ออกเป็นสองประเภทหลัก ดังนี้

- **แผนที่ทั่วไป (General Map)**  
แผนที่ทั่วไปจะแสดงตำแหน่งของข้อมูลที่มีข้อมูลอยู่หลายประเภทเพื่อใช้งานได้หลายเรื่อง เช่น แผนที่ฐาน Base Map แผนที่ภูมิประเทศ เป็นต้น
- **แผนที่เฉพาะเรื่อง (Thematic Map)**  
เป็นแผนที่แสดงข้อมูลเฉพาะเจาะจงใดเรื่องหนึ่ง แบ่งเป็น 2 ประเภท
  1. แผนที่เฉพาะเรื่องเชิงคุณภาพ (Qualitative)
  2. แผนที่เฉพาะเรื่องเชิงปริมาณ (Quantitative)

# Keynote presentation 9: Database Management (Thai)

Arc GIS 10.1

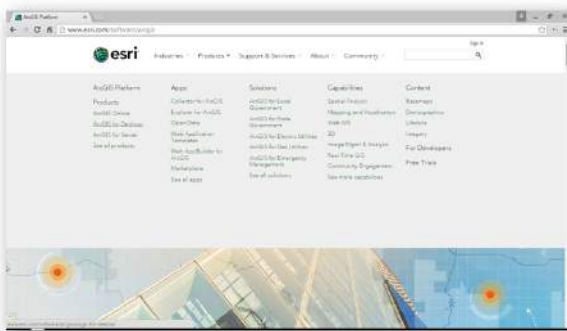
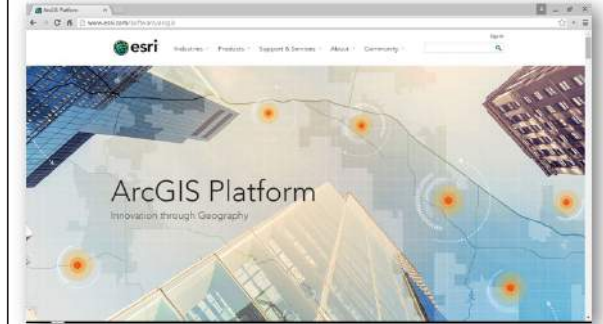




# Keynote presentation 10: ArcGIS Download (Thai)

## Download ArcGIS

Trail 60 day



# Keynote presentation 11: Step by Step HECRAS Modelling (Thai)

**Modeling tools for water resources management.**

## คู่มือการใช้งาน โปรแกรม HEC-RAS

โดย  
**โกวิท บุญรอด**  
**Mr. Kowit Boonrawd**

**Modeling tools for water resources management.**

## คู่มือการใช้งาน โปรแกรม HEC-RAS

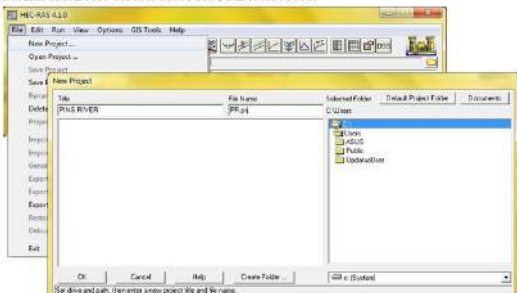
1. การดำเนินการสร้างแบบจำลอง HEC – RAS
- 1.1 การเริ่มโปรแกรม โดยการคลิกที่ ไอคอน โดยการ Double Clicks หรือ Right Click แล้วเลือก Open
- 1.2 เมื่อเปิด โปรแกรมสำเร็จ เพื่อเป็นการตั้งค่าหน่วยที่จะใช้ในการวิเคราะห์ โดยการเลือกที่ Options แล้วไปที่ Units system (US Customary/SI) ... เพื่อเลือก หน่วยที่ต้องการจะใช้ในการสร้างแบบจำลอง



ภาพที่ 1 หน้าต่างแสดงการตั้งหน่วยเริ่มต้นของ

## คู่มือการใช้งาน โปรแกรม HEC-RAS


- 1.3 เลือก File เพื่อไปที่ New Project... เพื่อสร้างแฟ้มข้อมูลของงานที่วิเคราะห์และเลือกตำแหน่งที่ตั้งที่จะบันทึกไฟล์



ภาพที่ 2 หน้าต่างแสดงการสร้างแผนงานเริ่มต้นของแม่น้ำปิง

## คู่มือการใช้งาน โปรแกรม HEC-RAS


- 1.4 การสร้างลักษณะแนวลำน้ำในการวิเคราะห์โดยการไปที่ Edit เลือก Geometric Data หรือเลือกที่ไอคอน เมื่อปรากฏหน้าต่างดังรูป ไปที่ File เพื่อสร้างแฟ้ม ข้อมูลที่ New Geometric Data



ภาพที่ 3 หน้าต่างแสดงการเริ่มสร้างข้อมูลทางภูมิศาสตร์

## คู่มือการใช้งาน โปรแกรม HEC-RAS

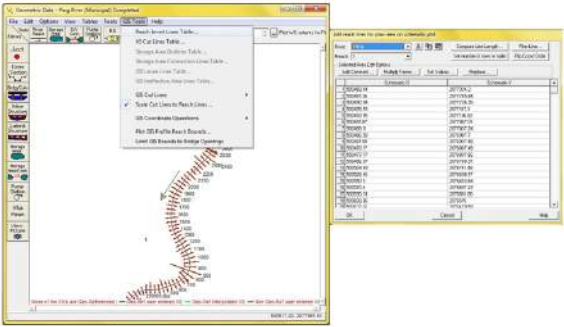
- 1.5 เลือก เพื่อวาดแนวลำน้ำเริ่มจากทาง ต้นน้ำ (Upstream) ไปทาง ปลายน้ำ (Downstream) แล้ว Double – Click เพื่อกำหนดชื่อของลำน้ำ



ภาพที่ 4 หน้าต่างแสดงการสร้างแนวการไหลลำน้ำของแม่น้ำปิง

## คู่มือการใช้งาน โปรแกรม HEC-RAS

- 1.6 เพื่อให้ได้แนวลำน้ำที่แม่นยำจริง ไปที่ GIS Tools เลือก Reach Invert Lines Table... เพื่อใส่ค่าที่วัดและตั้งจุดของลำน้ำที่ Schematic X, Schematic Y (ค่าที่นำมาใส่เป็นหน่วย UTM) แล้วกด OK



ภาพที่ 5 หน้าต่างแสดงการกำหนดแนวลำน้ำ โดยใช้พิกัดทางภูมิศาสตร์ UTM



**Some Basics of  
HEC-RAS  
River Analysis System**

**August 2006**

**CRWR Online Report 99-1**

**Floodplain Mapping Using HEC-RAS and ArcView GIS**

by

Eric Tate, M.S.E.

Graduate Research Assistant

and

David Maidment, PhD.

Principal Investigator

May 1999

**CENTER FOR RESEARCH IN WATER RESOURCES**

Bureau of Engineering Research • The University of Texas at Austin  
J.J. Pickle Research Campus • Austin, TX 78712-4497

This document is available online via World Wide Web at  
<http://www.ce.utexas.edu/centers/crwr/reports/online.html>





**US Army Corps  
of Engineers**  
Hydrologic Engineering Center

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# HEC-RAS



## River Analysis System

Applications Guide

Version 4.1  
January 2010

Approved for Public Release. Distribution Unlimited

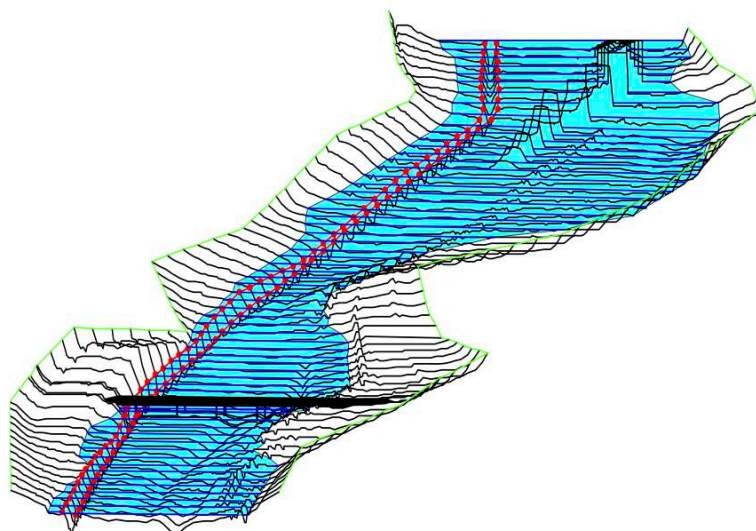
CPD-70



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# HEC-RAS River Analysis System



## Hydraulic Reference Manual

Version 4.1  
January 2010

Approved for Public Release. Distribution Unlimited

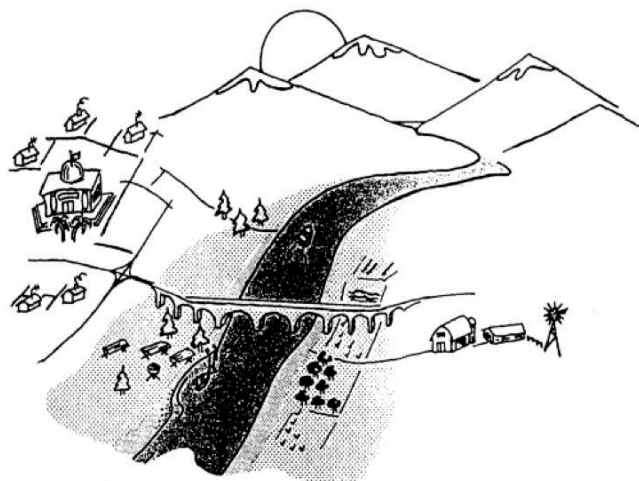
CPD-69



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# HEC-RAS

## River Analysis System

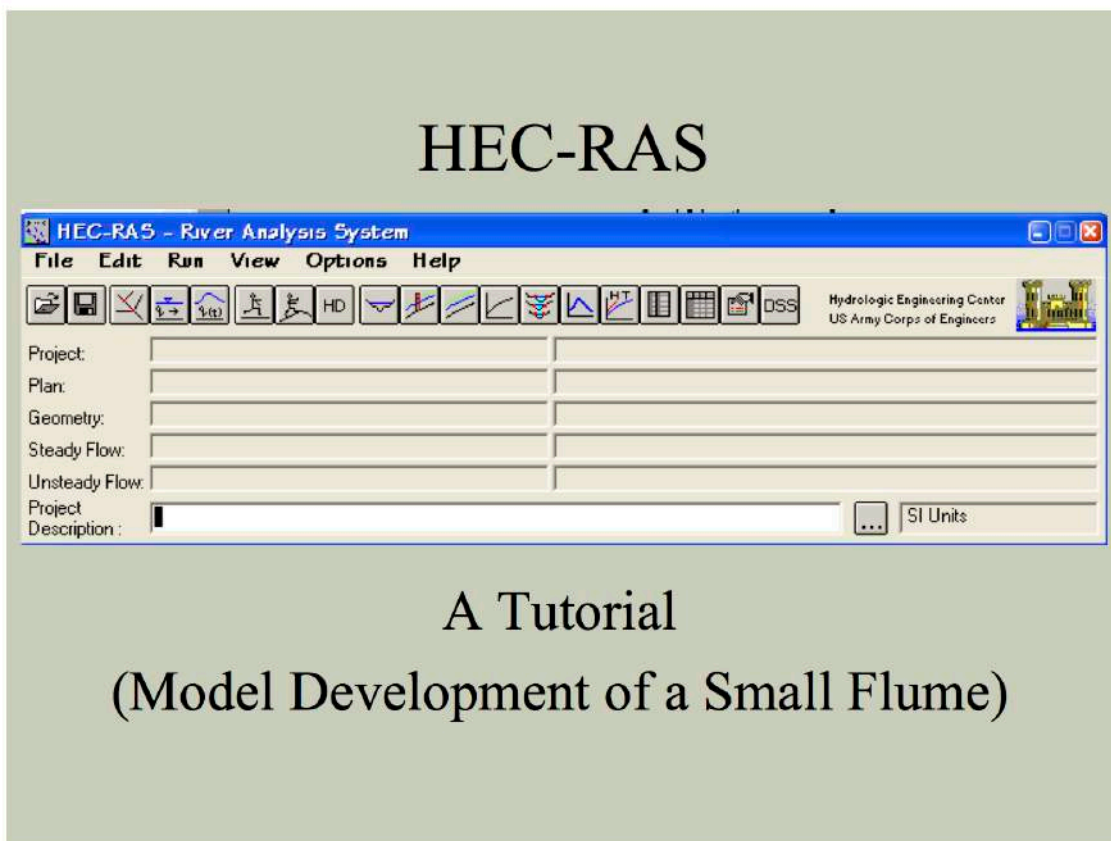


### User's Manual

Version 4.1  
January 2010

Approved for Public Release. Distribution Unlimited.

CPD-68



## A Tutorial (Model Development of a Small Flume)





# **Training Manual for Water Quality Management and Monitoring**



# I. Fact Sheet

Name of training course:

**Water Quality Management and Monitoring**

Level and specialty:

Basic and Specialization

After the training, the trainees will:

**First stage:**

- Gain a broad perspective of water quality management and getting a good understanding of the diversified challenges that must be tackled when drafting Water Quality Projects and Programs.
- Gain general skills in water quality monitoring and assessment (key parameters to be monitored, sampling methods, laboratory tests, observation in situ, data management and specific studies).
- Gain skills in water quality regulatory framework and law enforcement mechanisms.
- Gain skills in setting up an enabling institutional framework aiming at coordinating and networking the various institutions (public and private).
- Gain skills in data sharing, transparent communication and awareness campaigns with the various stakeholders (in this case, strong websites or portals and social media may be a key tool).
- Building team spirit among the participants.

**Second stage:**

- Understand the link to the most common sources of pollution in Lao PDR and the related parameters of water quality which are important to be collected, and have knowledge of international or regional standards for evaluating the risks.
- Understand the methods for measuring these parameters: which parameters needs sampling and tests in laboratories, which parameters may be simply analyzed in situ.
- Will be familiarized with the concept of Integrated Water Quality Management with the roles of the Central Decentralized agencies and the potential role of local authorities and communities.
- Gain knowledge on qualitative observations that may be carried out by communities and how to connect these community-based observations with decentralized agencies (roles and communication lines) for improving crisis management.

Target groups:

This training was divided into two parts, 1) Water Quality Management Training that aimed to build basic understanding of standard water quality management projects and programs, and institutional set up in general, and 2) Water Quality Monitoring Training that aimed to build up scientific knowledge and skills in water quality monitoring and assessment in standard parameters.

The trainees include members from:

- Nam Ngum River Basin Secretariat;
- Governmental water agencies, and central, provincial, district and sub-district levels;
- National University of Laos;
- Hydropower operators, and;
- Local communities and impacted groups.

Number of training days:	7 days
Dates and venue of training:	Nam Ngum River Basin, Thalad Province
Number of trainees:	63
List of trainees:	See Annex A-9
List of principal trainers:	Dr. Vithet Srineth, Senior Program Manager, EMSP Dr. Nguyen Thanh Tin, Senior Water Quality Specialist, EMSP
Training methodologies:	<ul style="list-style-type: none"> <li>• Series of Stakeholder Consultations.</li> <li>• Series of field practice in field water monitoring.</li> <li>• Keynote presentation an class work.</li> </ul>
Training materials:	<ol style="list-style-type: none"> <li>1. Situational Analysis, Training Concepts and Training Modules</li> <li>2. Training Program Agenda with Training Methodologies</li> <li>3. Manuals</li> <li>4. Water Quality Tool Kit</li> <li>5. Keynote Presentations</li> </ol>
Recommended additional reference materials:	<ol style="list-style-type: none"> <li>1. <a href="http://www.mrcmekong.org/topics/environmental-health">http://www.mrcmekong.org/topics/environmental-health</a></li> <li>2. <a href="http://www.wepa-db.net/pdf/0810forum/paper18.pdf">http://www.wepa-db.net/pdf/0810forum/paper18.pdf</a></li> <li>3. <a href="http://siteresources.worldbank.org/NEWS/Resources/report-en.pdf">http://siteresources.worldbank.org/NEWS/Resources/report-en.pdf</a></li> </ol>
Training assessment results and findings:	<p>The Training series in stakeholder consultation on water quality management met its objective in facilitating fruitful dialogue and assembling the integrated institutional set-up of Nam Ngum Water Quality Management. The trainees found that the water pollution disaster that perhaps resulted from the operation of Nam Ngum I and II Hydropower very critical. They proposed to form up a multi-disciplinary team that can coordinate the NN water quality issue, as well as to facilitate all key stakeholders, build up capacity of stakeholders and enforce regulations.</p> <p>The training series in water quality monitoring was conducted and led by EMSP and was highly successful. The trainees were given a test at the training and proven that more than 80% of the trainee gained over 70% of the scores.</p>
Next steps and Recommendations:	<ol style="list-style-type: none"> <li>1. The training in water quality monitoring to Nam Ngum stakeholders should be continued after the TA finished. At least, every 3 months.</li> <li>2. The training should be reached to impacted communities.</li> <li>3. The dialogue on the water quality in Nam Ngum should be continually facilitated and involve the decision makers at provincial and central levels in the next stage.</li> </ol>



## II. Situation Analysis, Training Concepts and Training Modules

### Water Quality Management (Part I): Stakeholder dialogues and consultations

#### A. Justification

Experience world-wide shows that developing Water Quality Management (WQM) may prove to be very challenging for several reasons:

- It is a multi-disciplinary and multi-sectoral topic that aims to achieve various objectives. For instance, several key institutions are deeply concerned with various aspects that are correlated to water quality, such as human health, environment, agriculture, urban planning, industry, tourism, etc.
  - Issues may be very specific according to local conditions, e.g.:
    - Diffuse pollution (nitrogen and phosphorus), due to overuse of fertilizers that may affect surface water quality and the related ecosystems;
    - Consequent groundwater deterioration that put water supply at risk and may generate serious health concerns;
    - Uncontrolled industrial or mining effluents that may put the population in great danger in terms of health or even life and that may generate substantial loss in fish production;
    - Insufficient or uncontrolled wastewater treatment plants, and/or improper reject of effluents that may equally generate health problems and loss of biodiversity including in fish production, or;
    - Uncontrolled waste disposal that affect both surface water (through runoff) and groundwater (through infiltration). Some toxic elements may even cause quasi-irreversible damages to the groundwater resources and jeopardize the use of such water for generations.
  - Water quality management is part of what we generally call "Water Security Management" together with flood and drought. Water quality is therefore one of the major risk to be assessed and managed but to a large extent, it is less predictable and often less reversible than flood or drought.
- Apart from accidental events, water quality deterioration is generally a slow process made of cumulative impacts of small pollution sources often difficult to identified and sometimes located far from the points of observations.
- Legal framework, public awareness and law enforcement to mitigate sources of pollution are key strategic lanes to be put in place. But many actors, largely from the private sectors, have a role to play in that sense, e.g.:
    - Farmers and Concession Holders to better control the use of fertilizers and pesticides;
    - Industrial and Mining Companies to comply with standards for effluent discharge;
    - Municipalities to invest in appropriate wastewater treatment plants;
    - Scientific community to develop studies and surveys that allow better understanding of links between surface water and aquifer and mechanisms of dilution of pollutants, and;
    - Public Authorities to regulate, create awareness and coordinate the actors, private and publics.
  - Water quality assessment may prove to be technically complex and expensive. Some parameters may be measured easily in situ (temperature, conductivity, pH, etc.) but others required thorough procedures for proper sampling in field and test in laboratories.
  - Water quality monitoring needs flexibility. In case of accidental pollution, the staff should be at the right place at the right time, which is rarely the case. Sources of pollution can occur only during a few hours and rarely when sampling is done. Complex sampling and test in situ are very expensive process that may be rarely afforded or justified. The law enforcement through "environmental policy" is a major challenge in itself.
  - Due to the high costs in equipment and the need to build team with highly skilled staff, it is essential to avoid institutional and resources duplication. It means that a high level of coordination mechanisms should be set up. Networking the information between the relevant institutions is "a must". The institutional framework must be built with such objective.



- Public involvement is an essential factor of success as shown in many places world-wide:
  - Appropriate awareness may lead to more careful use of damaging substance (farmers have a key role to play and must be educated accordingly);
  - River watchers or Volunteers observation may be an interesting and cheap solution for carrying out some local observations and reporting, and to raise awareness, and;
  - Principles and methods ensuring transparency in sharing information among the public and the public sector (website with online data) must be developed and implemented as well as communication strategies and public awareness campaigns.

In Lao PDR, water quality management is a quite new topic. The likely reason is that up to recently, they were no apparent sign of serious degradation of surface and groundwater. Although the situation is still generally rather good now, the rapid pace of development, with extending urban areas or semi-urban areas, industrial zones, mining activities and increasing in farming productivity, the situation may decline. It makes that it is likely the right momentum to develop proper strategies both in terms of water quality assessment and risks management.

At MONRE level, we have identified 4 departments that deal with water quality management: DWR (Department of Water Resources), NERI (National Environmental Research Institute), DPC (Department of

Pollution Control), DEP (Department of Environmental Promotion). In addition, EMPS (Environment Management Support Program – funded by Gov. of Finland) must be associated.

In terms of activities, it is important to mention:

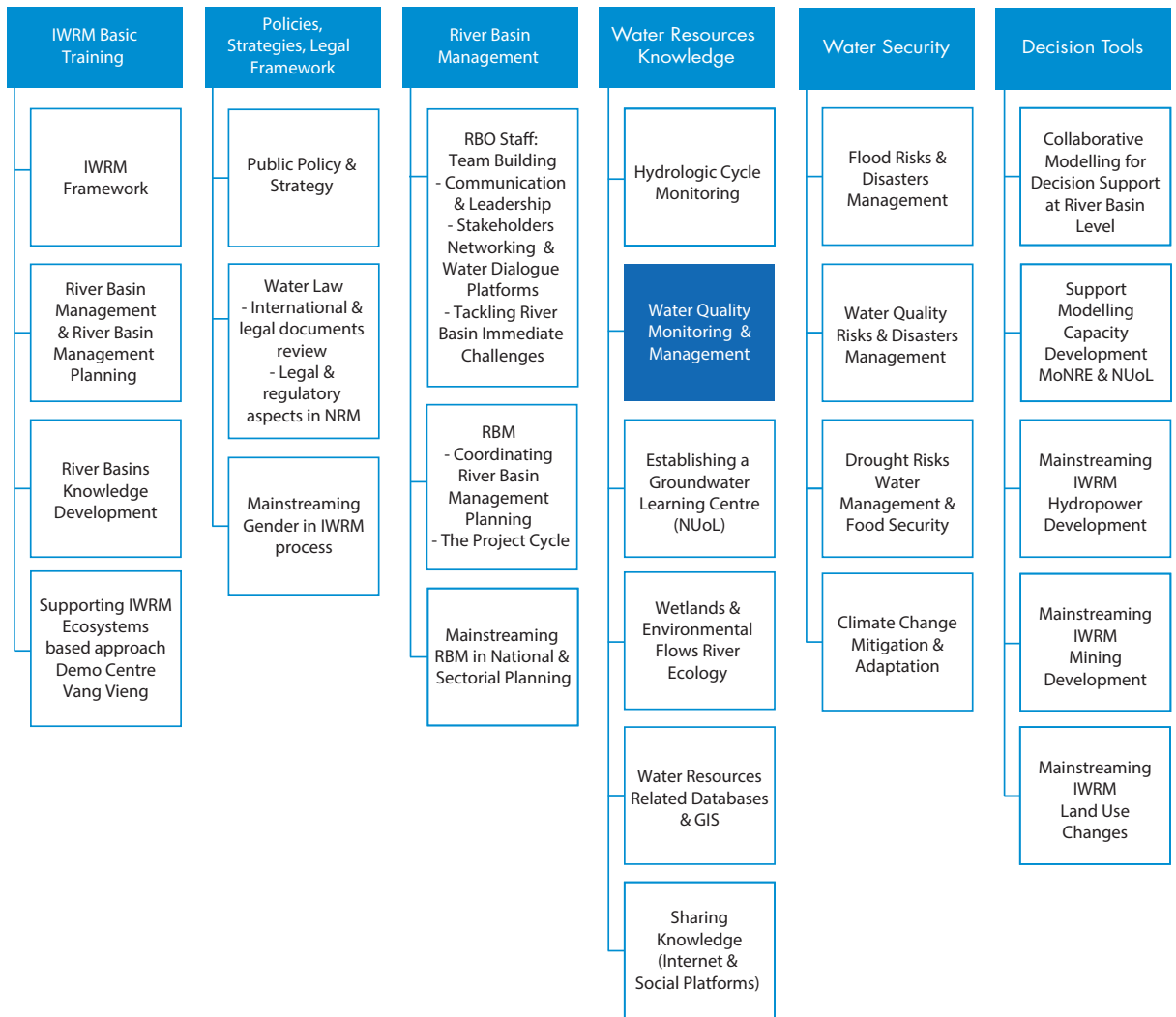
- “Demonstration on Integrated Water Quality Management in Nam Ngum River Basin in Lao PDR”, implemented by MONRE, and the provinces of Vientiane, Luang Prabang and Xien Khuang with the support of the Government of Finland;
- Supply of laboratory equipment to NERI, supported as well by the Government of Finland, and;
- Various other activities which are generally components of projects, like Nam Ton, Nam Song, etc.
- For all reasons explained above, Water quality Management is likely a key topic in terms of capacity building and training keeping in mind the wide range of sub-topics that must be covered to tackle the challenges. Actually this training integrates two different training topics:
  - Water Quality Assessment, that includes water quality monitoring, data bases, studies, impact assessment, models, and;
  - Water Quality Risk Management that includes regulatory framework, institutional arrangements, mitigation measures, public involvement, and awareness.



These two topics are very different in terms of content and therefore in terms of target participants, but there are at the same time very related as water quality assessment is a tool for building water quality risk management strategies and operational programs and projects.

The next figure allow to localize these 2 topics within the framework of the Training Plan.

**Figure 30: Training Plan Organization Chart**



## B. Expected Outputs

The Training will aim at covering the different topic that need to be tackle when developing water quality management strategy and related action plans.

The expected outputs are:

- Getting a broad perspective of water quality management and getting a good understanding of the diversified challenges that must be tackled when drafting Water Quality Projects and Programs;
- Getting general skills in water quality monitoring and assessment (key parameters to be monitored, sampling methods, laboratory tests, observation in situ, data management and specific studies);
- Getting skills in water quality regulatory framework and law enforcement mechanisms;
- Getting skills in setting up an enabling institutional framework aiming at coordinating and networking the various institutions (public and private);
- Getting skills in data sharing, transparent communication and awareness campaigns with the various stakeholders (in this case, strong websites or portals and social media may be a key tool);
- Getting skills in implementation of community-based observation projects (river keepers, volunteers observation, etc.), and;
- Building team spirit among the participants.

The topics that will be covered by this training are listed below :

### Section 1: Broad perspective of water quality management

- Introduce mandates, current activities and perspectives of the Departments of MONRE in charge of managing water quality: NERI, DPC, DEP, DWR (Service Water Quality) and EMPS as major program presently carried out in this sector.
- Develop what is behind the concept of Water Quality Management.
- Present the topics developed in section 2 to 6 and cross-check with the participants that they cover all range of issues related to water quality management in Lao PDR.

### Section 2: Tools for water quality monitoring and assessment

- Drafting water monitoring plan.
- Conducting water sampling and in situ measurements.

- Develop data bases, GIS tools for mapping and models.
- Ensure that procedures for water sampling, in situ measurement, laboratory certification and data management comply with standard of water quality management referring to Lao regulation or to similar regulation applied in the region or by International Organizations.

### Section 3: Water quality risks assessment

- Identify critical water pollution sources and areas sensitive to water pollution.
- Mapping and assessing risks of water pollution.
- Advise on water quality monitoring actions and investigations to respond to pollution cases.

### Section 4: Coordinating and networking water quality activities

- Guidelines on how to coordinate water quality management among the different actors involved in this topics.
- Assessment of water quality data and reporting to agencies and stakeholders.

### Section 5: Communication and awareness

- Develop strategies for water quality data dissemination among agencies and stakeholders.
- Develop strategies of communications and awareness.

### Section 6: Methodologies and guidelines for developing Village Volunteers observation projects

- Develop methodologies and guidelines to involve Environmental Volunteers in water quality monitoring.
- Techniques of water sampling and analysis and reporting that can be applied by Environmental Volunteers.

## C. Training Methodology

The preliminary step will be to organize the training/workshop on **“Broad Perspective of Water Quality Management” (Section 1)**. It will allow starting networking the different Departments and Projects that are related to water quality management, and to check that sections 2 to 6 fit with the specific needs.

After section 1 will have been completed, this concept note will be updated accordingly.



## D. Proposed Organization

Modules	Brief Content	Target Trainees	Resource Person
<b>Section 1: Broad perspective of water quality management</b>			
<b>Module 1</b>	Introduce mandates, current activities and perspectives of the Departments of MoNRE in charge of managing water quality: NERI, DPC, DEP, DWR (Service Water Quality) and EMPS as major program presently carried out in this sector.	Staff from: NERI, DWR (WQM Service), DPC, DEP, EMPS	ICHARM
<b>Module 2</b>	Develop what is behind the concept of Water Quality Management.	Staff from: NERI, DWR (WQM Service), DPC, DEP, EMPS	Facilitator
<b>Module 3</b>	Present the topics developed in section 2 to 6 and cross-check with the participants that they cover all range of issues related to water quality management in Lao PDR.	Staff from : NERI, DWR (WQM Service), DPC, DEP, EMPS	Facilitator
<b>Section 2: Tools for water quality monitoring and assessment</b>			
<b>Module 1</b>	Drafting water monitoring plans.	To be set up after completion of section 1	
<b>Module 2</b>	Conducting water sampling and in situ measurements.	To be set up after completion of section 1	
<b>Module 3</b>	Develop data bases, GIS tools for mapping and models.	To be set up after completion of section 1	
<b>Module 4</b>	Ensure that procedures for water sampling, in situ measurement, laboratory certification and data management comply with standard of water quality management referring to Lao regulation or to similar regulation applied in the region or by International Organizations.	To be set up after completion of section 1	

Modules	Brief Content	Target Trainees	Resource Person
<b>Section 3: Regulatory and enforcement framework</b>			
<b>Module 1</b>	Identify critical water pollution sources and areas sensitive to water pollution.	To be set up after completion of section 1	
<b>Module 2</b>	Mapping and assessing risks of water pollution.	To be set up after completion of section 1	
<b>Module 3</b>	Advise on water quality monitoring actions and investigations to respond to pollution cases.	To be set up after completion of section 1	
<b>Section 4: Coordinating and networking water quality activities</b>			
<b>Module 1</b>	Guidelines on how to coordinate water quality management among the different actors involved in this topics.	To be set up after completion of section 1	
<b>Module 2</b>	Assessment of water quality data and reporting to agencies and stakeholders.	To be set up after completion of section 1	
<b>Section 5 : Communication and awareness</b>			
<b>Module 1</b>	Develop strategies for water quality data dissemination among agencies and stakeholders.	To be set up after completion of section 1	
<b>Module 2</b>	Develop strategies of communications and awareness.	To be set up after completion of section 1	
<b>Section 6 : Methodologies and guidelines for developing Village Volunteers observation projects</b>			
<b>Module 1</b>	Develop methodologies and guidelines to involve Environmental Volunteers in water quality monitoring.	To be set up after completion of section 1	
<b>Module 2</b>	Technics of water sampling and analysis and reporting that can be applied by Environmental Volunteers.	To be set up after completion of section 1	

## E. Time Frame

The **Section 1, “Broad perspective of water quality management”**, should be organized in a two days workshop. The time frame for the other sections will be set up after getting conclusion of Section 1.

## Water Quality Monitoring (Part II): Water Quality Monitoring Exercises

### A. Justification

A training module on water quality management, as part of the general topic “Water Security” was recently developed and organized<sup>21</sup> within the framework of this NIWRMSP- Component 1 – Training Program. During that training, different aspects related to water quality management were presented:

- Broad perspective of what does mean “water quality management” and the diversified challenges that must be tackled when drafting Water Quality Projects and Programs.
- General overview of the ways to conduct water quality monitoring and assessment.
- General overview on water quality regulatory framework and law enforcement mechanisms.
- General overview on how to enable an adequate institutional framework aiming at coordinating and networking the various institutions (public and private) in charge of water quality management.
- General overview on the topics of data sharing, transparent communication and awareness campaigns with the various stakeholders.
- General overview of the potential of community-based observation projects.
- One of the objectives of this training was also to explore the key present issues in terms of water quality management from the perspective of the participants. A group exercise was organized accordingly. In summary:
  - Difficulty to manage emergency crisis and response in case of disaster: lack of field monitoring, weaknesses in the communication lines between the agencies in charge of such issues, weaknesses in the definition of role and tasks.
  - Another issue that was often mentioned is the difficulty to monitor the quality of water with limited resources at agencies level (skilled personal, laboratories capacities and field equipment). This is significant weakness that generally jeopardizes quick assessment of critical situations and quick responses to crisis.

There is therefore a strong need to reinforce the legal and enforcement rules as well as the institutional framework for water quality management and procedures for response to crisis. This is normally under the responsibility of the central Government and it will be addressed in further modules.

Nevertheless, also in response to the key issues raised by the participants of the first training module on water quality management, improving water quality monitoring is clearly an immediate priority and should be mainly addressed by the decentralized authorities (Provinces, Districts, Kum Ban) with involvement of the Communities which are actually the most directly affected by potential problems or even disasters.

The present concept note will therefore focus on the specific topic: “Water Quality Monitoring”.

Water Quality Monitoring has been poorly addressed up to very recently in Lao PDR. It is likely because Water Quality issues are quite new as a consequence of recent fast development of hydropower, mining activities, urban areas, industries and intensive agriculture. Although, many “stand-alone” projects have integrated this aspect in their activities, these actions do not contribute enough to reach a critical mass in terms of capacity building and institutional organization for really creating a momentum on this topic.

Nevertheless, in very summary, we may note two significant activities at MoNRE level, one within the framework of the Mekong River Commission, and one within the framework of the EMSP<sup>22</sup>. One of the most relevant studies organized within the EMSP’s framework was a detailed survey of the water quality in the Nam Ngum reservoirs and downstream. This study was presented during the training module mentioned at the beginning of this note and clearly pointed out critical water quality issues in this area.

Another very interesting activity developed within the EMSP was the “Demonstration Project on Integrated Water Quality Management in Nam Ngum River Basin”. The project aimed at covering the different aspects of water quality management similarly to those developed in the already mentioned training module, emphasizing the needs to strongly involve the decentralized agencies and the local stakeholders, especially in terms of monitoring and response to crisis. This project was completed in early 2012.

21. Talad District, Vientiane Province: 30 June - 1 July 2014

22. Environnemental Management Support Program

The support from MRCS and the EMSP are a very valuable base for making steps forward in a more consistent approach for water quality management. The most critical and not yet solved issues remain nevertheless the need to disseminate water quality management throughout the country ensuring managerial, technical and financial sustainability.

Water quality monitoring may prove to be a very expensive sector if not properly planned in terms of priorities and resources, especially if organized on a centralized way, where field realities and priorities may not appear clearly. For that reason, the central government should focus on legal and enforcement frameworks, bring support in terms of laboratories, and, in case of exceptional disaster, bring appropriate support to the local authorities and population. Water Quality Monitoring in general should be the responsibility of the provinces, districts and Kum Ban/villages, and/or the River Basin Authorities, the central Government keeping a normative and supervisory role.

The capacity building for the technical aspects of Water Quality Monitoring should be therefore focused on the decentralized authorities and Communities. In such perspective, the challenge remains actually the limited skills and resources of these agencies and stakeholders and the question is: how to transform “Demonstration project”, like the one already developed by ESMP in one river basin, into sustainable day by day activities throughout the country. This would be also a key question at the heart of this module on Water Quality Management.

One possible entry point is to give more skills and responsibilities to the communities living along the rivers. This concept was already implemented very successfully in many countries in the world, one example being the River Detectives in Thailand<sup>23</sup>. The “river observers” are often selected on a volunteer basis or through local schools and colleges. Limited observation equipment allows identifying microbiology in the rivers and this is related to the water quality. When something wrong is observed, then more sophisticated means of investigation may be called on and immediate action can be taken if needed. The major advantages are: low cost monitoring, quick response and awareness generating.

In this context, it is interesting to mention that the Asia Foundation<sup>24</sup> has developed, in Lao PDR, a methodology to allow the decentralized institutions and the population to play an influential role in protecting their rivers by engaging them in decision-making and building their capacity to support environmental protection. This already started in Vang Vieng District. Supporting the local communities to have skilled for self-monitoring the water quality is a core activity of this project. The Asia Foundation is likely a key partner and resource for developing this module.

It is therefore suggested to address the following topics in this module:

- Which are the parameters of water quality that are important to be collected and reference to international or regional standards? The most common possible sources of pollution in Lao PDR will be listed showing the possible impact on the water quality parameters.
- Different methods for measuring these parameters: which parameters needs sampling and tests in laboratories, which parameters may be simply analysed in situ.
- How direct qualitative observations by communities may help better organizing and targeting water quality tests and bring faster response to emergency or crisis situation.
- How to coordinate community-based observation systems and decentralized agencies tasks (communication lines, etc.).
- During this workshop, a site visit should be organized to get a better perception of the potential and challenge of such approach.

## B. Expected Outputs

The outputs of this training module are:

- The trainees understand the link to the most common sources of pollution in Lao PDR and the related parameters of water quality which are important to be collected. They have knowledge of international or regional standards for evaluating the risks.
- The Trainees understand the methods for measuring these parameters: which parameters needs sampling and tests in laboratories, which parameters may be simply analysed in situ.

23. e.g.: River Detective <https://www.youtube.com/watch?v=CpxweDYXtc0>

24. <http://asiafoundation.org/media/view/slideshow/100/improving-water-quality-in-laos>



- The Trainees will be familiarized with the concept of Integrated Water Quality Management with the roles of the Central Decentralized agencies and the potential role of local authorities and communities.
- The Trainees will get knowledge on qualitative observations that may be carried out by communities and how to connect these community-based observations with decentralized agencies (roles and communication lines) for improving crisis management.

## C. Main Topics Covered

The Modeling module would be composed of two sections:

### 1. Quantitative Monitoring of Water Quality Parameters in the context of Lao PDR

- Parameters to be monitored in Lao PDR according to the most common pollution sources.
- Standard to be applied for evaluating the risks (International, regional, national).
- Procedure to apply to monitor these parameters (sampling and test in laboratories, tests in situ).
- Resources (skilled personal, laboratories and equipment) and costs (tests in laboratories, tests in situ).

### 2. Qualitative monitoring of Water Quality through community based observations

- Methodology to be applied and expected advantages for optimization of water quality monitoring campaigns and crisis management.
- The concept of “Integrated Water Quality Management”: Connecting community observations and authorities (Provinces, Districts) in charge of WQM & local disaster management.

## D. Methodology

### Section 1: Quantitative Monitoring of Water Quality Parameters in the context of Lao PDR

- Presentation of the water quality parameters and the related standards.
- Presentation of the most common sources of pollution in Lao PDR and their impacts on specific parameters.
- Group discussion on which parameters are the most important to be observed.
- Methods of monitoring: tests in laboratories, tests in situ, micro-biological observations.



## Section 2: Qualitative monitoring of Water Quality through community based observations

- Presentation of the case-study: Improving Water Quality in Laos – Integrated Water Quality Management – The Asia Foundation.
- Group Exercise and report: SWOT analysis of this case-study.

- Plenary discussion: Key recommendations for improving local capacities for water quality monitoring and response to crisis.

## E. Proposed Organization

Modules	Brief Content	Program	Resource Person
<b>Section 1 : Quantitative Monitoring of Water Quality Parameters in the context of Lao PDR</b>			
<b>Module 1</b>	Presentation of the water quality parameters and the related standards.	Formal presentation and questions	EMSP
<b>Module 2</b>	Presentation of the most common sources of pollution in Lao PDR and their impacts on specific parameters.	Formal presentation and interactive discussion	EMSP
<b>Module 3</b>	Group discussion on which parameters are the most important to be observed.	Working Group	EMSP & The Asia Foundation
<b>Module 4</b>	Methods of monitoring for the : tests in laboratories, tests in situ, micro-biological observations.	Formal presentation and interactive discussion	EMSP & The Asia Foundation
<b>Section 2 : Qualitative monitoring of Water Quality through community based observations</b>			
<b>Module 5</b>	Presentation of the case-study: Improving Water Quality in Laos – Integrated Water Quality Management – The Asia Foundation.	Formal presentation and questions	The Asia Foundation
<b>Module 6</b>	Group Exercise and report : SWOT analysis of this case-study.	Formal presentation and interactive discussion	The Asia Foundation
<b>Module 7</b>	Plenary discussion: improving local capacities for water quality monitoring and response to crisis: dissemination and sustainability.	Formal presentation and interactive discussion	The Asia Foundation

## F. Target Components/Focal Points

The institutions that have responsibilities in “Water Quality Monitoring” include:

- MONRE, and related provincial and district subsidiaries;
- NNRBC (and other existing or planned RBC), and;
- Communities (Vang Vieng , etc. ).

## G. Time Frame

Day 1: M1, M2, M3, M4

Day 2: M5, M6, M7

## III. Training Program Agenda

### **Part I: Stakeholder dialogues and consultations**

- Day 1** Understanding of water quality management and monitoring process
- Day 2** Understanding the key challenges and capacity building needs
- Day 3:** Understanding stakeholder and current water quality problem in the Nam Ngum River

### **Part II: Water Quality Monitoring Exercises**

- Day 1:** Introduction of Water Quality Monitoring and Water Quality Parameters
- Day 2:** Water Quality Sampling and field Survey
- Day 3:** Water Quality Database Management
- Day 4:** Strategy Development for Water Quality Assessment


# IV. Training Materials

## Part I: Stakeholder dialogues and consultations

### Keynote presentation 1: Introduction of Water Quality Management (Lao)

ສິ່ງທ້າທາຍໃນການ  
ຄຸ້ມຄອງຄຸນນະພາບນ້ຳ

NIWRMSP Building Capacity:  
Package 1  
Training : Water Quality  
Management



Eric Tilman  
International Consultant  
[www.riversnetwork.org](http://www.riversnetwork.org)

ແຫຼ່ງທີ່ມາຂອງມົນລະພິດທີ່ສົ່ງຜົນກະທົບຄຸນນະພາບນ້ຳ

- Non Point Sources
- Point Sources



ແຫຼ່ງທີ່ມາຂອງມົນລະພິດທີ່ສົ່ງຜົນກະທົບຄຸນນະພາບນ້ຳ— ທີ່ບໍ່ແມ່ນແຫຼ່ງທີ່ມາ

 <p>ປຸຍ/ຢາຂ້າ ຫຍ້າ</p>	 <p>ນ້ຳຈາກຝົນ ຕົກ</p>	 <p>ການເຜົາ ຂີ້ເຫຍື້ອ</p>
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**Keynote presentation 2: Capacity building in Water Quality Management in Lao PDR (Lao)**

**ການສ້າງຄວາມອາດສາມາດ  
ໃນການຕິດຕາມຄຸນນະພາບນໍ້າ**



Presented by Ms Tran Thi Kim Yen  
Thalad, 1<sup>st</sup> July 2014

**ແຜນນາງານຫຼັກ/ໂຄງການກ່ຽວກັບການຕິດຕາມຄຸນນະພາບນໍ້າ**



**ເລືອກຂ່າຍໃນການຕິດຕາມຄຸນນະພາບນໍ້າໃນທົ່ວປະເທດ**

- ✓ 93 ສະຖານີຕິດຕາມ  
ໃນ 17
- ✓ ຄວາມຖີ່ໃນການ  
ຕິດຕາມປະຈຳງວດ
- ✓ 4 ບ່ອນທີ່ໄດ້ອັດແຫງຢູ່  
ພາກສະຫນາມແລະ  
ຫລາຍກ່ວາ 20 ບ່ອນ  
ທີ່ໄດ້ທົດລອງ





# Keynote presentation 4: Water Quality Management Guidelines (Lao)



**ເນື້ອໃນເອກສານລວມມີ 3 ພາກ**

- I. ອາກສະເໜີ
  - 1. ຄວາມເປັນມາ
  - 2. ຈຸດປະສົງ
  - 3. ກຸ່ມເປົ້າໝາຍຜູ້ບໍາລິເວີ
- II. ໂຄງສ້າງແບບງານຄຸ້ມຄອງ ແລະ ການຕິດຕາມກວດກາຄຸນນະພາບນ້ຳ
  - 1. ຄວາມສຳຄັນຂອງການຕິດຕາມກວດກາຄຸນນະພາບນ້ຳ
  - 2. ບັນດາຕົ້ນສ່ວນ ແລະ ລະບົບການ ຄຸ້ມຄອງ ແລະ ຕິດຕາມກວດກາຄຸນນະພາບນ້ຳ
  - 3. ກົນໄກການປະສານງານ
- III. ການຕິດຕາມກວດກາ
  - 1. ຂັ້ນຕອນທີ 1: ການອອກແບບແບບງານ
  - 2. ຂັ້ນຕອນທີ 2: ການກະກຽມ, ການເກັບຮູ້ມູນ ແລະ ການວິໄຈ
  - 3. ຂັ້ນຕອນທີ 3: ການລວບລວມຮູ້ມູນ ແລະ ການຈຸດກອງ
  - 4. ຂັ້ນຕອນທີ 4: ການວິເຄາະ ແລະ ອ່ານຮູ້ມູນ
  - 5. ຂັ້ນຕອນທີ 5: ການລາຍງານ ແລະ ເຜີຍແຜ່ຮູ້ມູນ

**I ພາກສະເໜີ**

• ຄວາມເປັນມາ

ໃນປະຈຸບັນນີ້, ບັນຫາທາງສິ່ງແວດລ້ອມ ໂດຍສະເພາະແມ່ນບັນຫາຄຸນນະພາບນ້ຳ ໄດ້ເພີ່ມທະວີຄວາມຮຸນແຮງຂຶ້ນຢ່າງໄວວາຢູ່ໃນຫຼາຍພື້ນທີ່ ທີ່ມີແນວໂນ້ມວ່າຈະສົ່ງຜົນກະທົບຕໍ່ຊີວິດ ແລະ ສຸຂະອະນາໄມຂອງປະຊາຊົນ.

ບັນດາຂໍ້ມູນ ແລະ ຂໍ້ແນະນຳໃນຄູ່ມືສະບັບນີ້ ແມ່ນອີງຕາມແຫຼ່ງຂໍ້ມູນທີ່ໜ້າເຊື່ອຖືຈາກສາກົນ, ໄດ້ຈາກການ ພິມຂະຫຍາຍຜົດຮຽນທີ່ໄດ້ຖອດຖອນຈາກໂຄງການທົດລອງຕິດຕາມກວດກາຄຸນນະພາບນ້ຳຢູ່ໃນອ່າງນ້ຳຫຼິ້ນ.

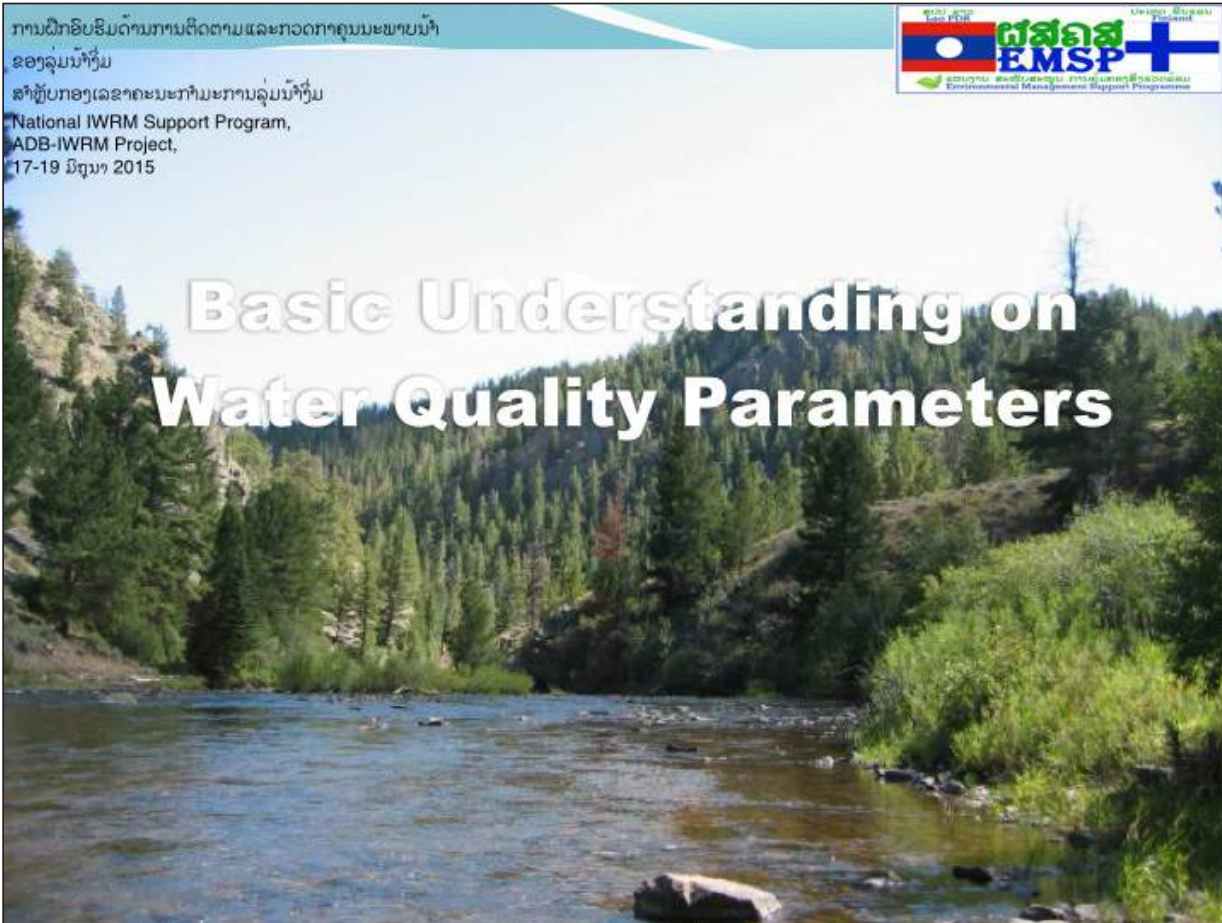
ການນຳໃຊ້ຄູ່ມືສະບັບນີ້ ເຂົ້າໃນການປະຕິບັດວຽກງານຕົວຈິງອາດຈະມີການໝູນໃຊ້ໃຫ້ມີຄວາມສອດຄ່ອງກັບຈຸດພິເສດຂອງບັນດາ ສາຍນ້ຳ ຢູ່ແຕ່ລະແຂວງ, ເມືອງ, ບ້ານ ແລະ ຂະແໜງການອື່ນໆຕາມຄວາມເໝາະສົມ.





## Part II: Water Quality Monitoring Exercises

### Keynote presentation 5: Basic knowledge of Water Quality Parameters (English)



## WATER COMPOSITION

1. Ionic composition  
2. Mineralization  
3. Dissolved organic matter  
4. Total and Permanent hardness

## IONIC COMPOSITION MINERALIZATION

1. Start from the atmosphere.
2. Smelted snow-cover.
3. Weathering (Mineralization)  
It's depending on rock structure, the soil and the vegetation.



## Keynote presentation 6: Basic knowledge of Aquatic Parameters (Lao)

ການຝຶກອົບຮົມດ້ານການຕິດຕາມແລະກວດກາຄຸນນະພາບນ້ຳ  
ຂອງລຸ່ມນ້ຳ  
ສຳຮູບກອງເລຂາຄະນະກຳມະການລຸ່ມນ້ຳ  
National IWRM Support Program,  
ADB-IWRM Project,  
17-19 ມິຖຸນາ 2015



### ຄວາມຮູ້ພື້ນຖານ

ດ້ານເຄມີຂອງນ້ຳ ການກວດກາແລະມາດຕະຖານຄຸນນະພາບນ້ຳໜ້າດິນ

(Basic on aquatic chemistry, surface water quality monitoring and standard)

ດຣ ວິເທດ ສີເນດ

ຊ່ຽວຊານສາກົນຫ້ອງທົດລອງ EMSP

ມິຖຸນາ 2015

### ເນື້ອຫາການອົບຮົມ

- 1) ເຄມີຂອງນ້ຳທຳມະຊາດ
- 2) ມາດຕະຖານສິ່ງແວດລ້ອມແຫ່ງຊາດ  
(ຄຸນນະພາບນ້ຳໜ້າດິນ)
- 3) ແນວທາງວິທີການເກັບຕົວຢ່າງນ້ຳ

- 1) ເຄມີຂອງນ້ຳທຳມະຊາດ

# Keynote presentation 7: Field Work Instruction in Water Quality Sampling Survey (Lao and English)

ການຝຶກອົບຮົມດ້ານການຕິດຕາມແລະກວດກາຄຸນນະພາບນ້ຳຂອງລຸ່ມນ້ຳຈຶ່ງມ

ສຳຮັບກອງເລຂາຄະນະກຳມະການລຸ່ມນ້ຳຈຶ່ງມ


National IWRM Support Program,  
ADB-IWRM Project,  
17-19 ມິຖຸນາ 2015



**ວິທີປະຕິບັດງານ**  
**ການຕິດຕາມກວດກາຄຸນນະພາບນ້ຳ**  
**(Work Instruction)**

ດຣ ວິເທດ ສີເນດ  
ຊ່ຽວຊານສາກົນຫ້ອງທົດລອງ  
ໂຄງການສະໜັບສະໜູນແລະຄຸ້ມຄອງສິ່ງແວດລ້ອມ (EMSP)

● 1



**Work Instruction for Water Sampling**

**Before**

- Sampling planning
- Checklist


**During**

- Safety arrangement
- Description of sampling location
- Field measurement
- Collection of samples

**After**


- Sample preservation
- Sample identification
- Sample storage and transport
- Field QA/QC

● 2



ການຝຶກອົບຮົມ ຫຼຽມຮຽນກວດກາຄຸນນະພາບນ້ຳ  
ເປັນລະດັບທຳອິດ ທີ່ມີຄວາມສຳຄັນ ທີ່ຈຳເປັນ  
18-19 ພຶສິກ 2014

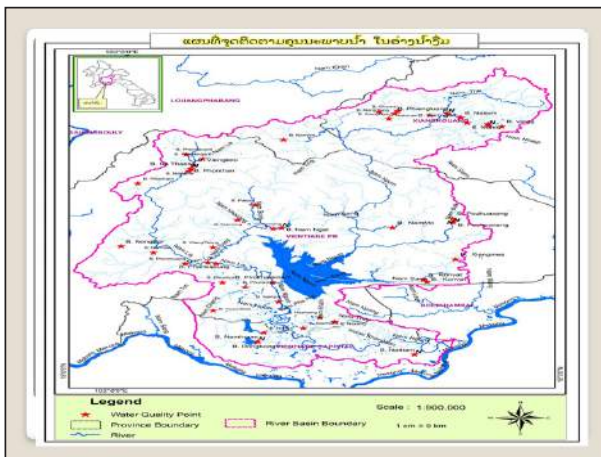
**A. ວຽກກ່ອນອອກພາກສະໜາມ**



 ••Sampling planning  
••Checklist

● 3

**Keynote presentation 8: Water Quality Monitoring Approach and Methods Used in the Nam Ngum River (Lao)**



ບັນດາຈຸດສະຖານນີ ແລະ ຈຸດຕິດຕາມກວດກາຄຸນນະພາບນ້ຳ ທີ່ນອນຢູ່ອ້າງຮັບນ້ຳກື່ມມີທັງໝົດ 49 ຈຸດ ກວມເອົາ 5 ແຂວງ ແຂວງ ນະຄອນຫຼວງວຽງຈັນມີ 4 ຈຸດສະຖານນີ

ລ/ດ	ຈຸດສະຖານນີ (ຈຸດຕິດຕາມ ແລະ ສະຖານນີ)	ບ້ານ	ເມືອງ	ແຂວງ
1	ຈຸດສະຖານນີທີ 1 ອ່າງນ້ຳ ຊວງ	ບ້ານສີມິໄລ	ເມືອງນາຊາຍ ຫອງ	ແຂວງນະຄອນຫຼວງ ວຽງຈັນ
2	ຈຸດສະຖານນີທີ 2 ສາຍນ້ຳ ຊວງ ກວັງຂິວ	ບ້ານນາກຸ່ງ	ເມືອງນາຊາຍ ຫອງ	ແຂວງນະຄອນຫຼວງ ວຽງຈັນ
3	ຈຸດສະຖານນີທີ 3 ສາຍນ້ຳ ຫຸນ	ບ້ານນ້ຳຫຸນ	ເມືອງນາຊາຍ ຫອງ	ແຂວງນະຄອນຫຼວງ ວຽງຈັນ
4	ຈຸດສະຖານນີທີ 4 ຫອງຫຼາມ	ບ້ານນາຫຼາມ	ເມືອງນາຊາຍ ຫອງ	ແຂວງນະຄອນຫຼວງ ວຽງຈັນ

**Keynote presentation 9: Strategies Development for Water Quality Monitoring in the Nam Ngum River (Lao)**

ການປຶກສາຮ່ວມຄວາມຄິດຕາມແລະກວດກາຄຸນນະພາບນ້ຳ  
ຂອງລຸ່ມນ້ຳຈຶ່ງມ  
ສຳຫຼັບກອງເຂົາຄະນະກຳມະການລຸ່ມນ້ຳຈຶ່ງມ  
National IWRM Support Program,  
ADB-IWRM Project,  
17-19 ມິຖຸນາ 2015



# ແນວທາງການປະເມີນຄຸນນະພາບນ້ຳ (Strategies on water quality assessment)

Dr Vithet Srinetr  
International Laboratory Advisor  
EMSP

ແນວທາງການປະເມີນຄຸນນະພາບນ້ຳ  
(Strategies for water quality assessment)



1. ການຕິດຕາມກວດກາຄຸນນະພາບນ້ຳໄລຍະຍາວ  
(Water Quality Monitoring)
2. ການສຳຫຼວດຄຸນນະພາບນ້ຳໄລຍະສັ້ນ  
(Water Quality Survey)
3. ການເປັນລະບົບຄຸນນະພາບນ້ຳເພື່ອການຕິດຕາມ  
(Water Quality Surveillance and Compliance monitoring)

1. ການກວດກາຕິດຕາມຄຸນນະພາບນ້ຳ  
ໄລຍະຍາວ  
(Water Quality Monitoring)



ການວັດແທກ, ການສັງເກດ, ການແປຜິນ, ການລາຍງານ ເພື່ອລະບຸ  
ສະຖານະພາບ ແລະ ທ່າວຸ່ງຂອງຄຸນນະພາບນ້ຳ ໃນໄລຍະຍາວ ແລະ  
ເປັນແບບແຜນມາດຕະຖານ (Long-term and standardised)




## Keynote presentation 10: Likely Causes Water Quality Pollution in the Nam Ngum River (English)

ການຝຶກອົບຮົມດ້ານການຕິດຕາມແລະກວດກາຄຸນນະພາບນໍ້າຂອງລຸ່ມນໍ້າ  
ສຳຫຼັບກອງເຂົາຄະນະກຳມະການລຸ່ມນໍ້າ  
National IWRM Support Program,  
ADB-IWRM Project,  
17-19 ມິຖຸນາ 2015



# Likely Causes of a Degradation of Water Quality OF NAM NGUM RIVER BASIN

Mr Nguyen Thanh Tin  
Regional advisor  
EMSP



### INLAND FRESH WATERS NAM NGUM RIVER BASIN

- Inland fresh waters are a parts of hydrological cycle in which we try to summary briefly and focus to general characteristics of flowing waters (rivers) and stagnant waters (lakes/reservoirs) within Nam Ngum River Basin.
- Rivers characterized with a relative high average flow velocity (0.1 – 1 m/s).
- Lakes characterized with a law average current velocity (0.001 – 0.01) at the surface



### NAM NGUM RIVER BASIN HYDROELECTRIC RESERVOIR

- Currently 6 reservoirs use for hydropower in the NNRB, but NN1 and NN2 are most important water resource which likely as head water of the Lower Nam Ngum River, the main water resource of Vientiane Capital and surrounding areas.
- Water quality in NN1 and NN2 reservoirs is an important problem that impacts to socio-economy development of Vientiane Capital and its surroundings.

# Keynote presentation 11: Water Quality Results and Status in the Nam Ngum River (Lao)

ການຝຶກອົບຮົມດ້ານການຕິດຕາມແລະກວດກາຄຸນນະພາບນ້ຳຂອງລຸ່ມນ້ຳຈຶ່ງມ  
ສຳຫຼັບກອງເລຂາຄະນະກຳມະການລຸ່ມນ້ຳຈຶ່ງມ  
National IWRM Support Program,  
ADB-IWRM Project,  
17-19 ມິຖຸນາ 2015




ຜົນການສຶກສາ  
ສະຖານະຂອງຄຸນນະພາບນ້ຳຂອງລຸ່ມນ້ຳຈຶ່ງມ  
ລະຫວ່າງປີ **2011 - 2015**  
Water Quality Status of Nam Ngum River Basin (2011-2015)

By Dr Vithet Srinetr  
International laboratory advisor (for Component 5)  
Environment Management and Support Programme  
Ministry of Natural Resources and Environment, Lao PDR

**ເນື້ອໃນ:**

- 1) ຂໍ້ມູນກາຍຍະພາບຂອງລຸ່ມນ້ຳຈຶ່ງມ
- 2) ການພັດທະນາ,ປະໂຫຍດຈາກການໃຊ້ນ້ຳຈຶ່ງມ
- 3) ການສຶກສາຄຸນນະພາບນ້ຳຂອງສາຍນ້ຳຈຶ່ງມ
- 4) ສະພາບຄຸນນະພາບນ້ຳສາຍນ້ຳຈຶ່ງມ
- 5) ຜົນກະທົບຈາກການພັດທະນາຕໍ່ຄຸນນະພາບນ້ຳ
- 6) ຄວາມທ້າທາຍສຳຄັນໃນການຄຸ້ມຄອງຄຸນນະພາບນ້ຳສາຍນ້ຳຈຶ່ງມ
- 1) ແນວທາງສູ້ຊີນແລະແຜນປະຕິບັດໃນອະນາຄົດ



**1) ຂໍ້ມູນກາຍຍະພາບຂອງນ້ຳຈຶ່ງມ**

- ນ້ຳຈຶ່ງມ ໂຫລປອງໃສ່ພາກກາງຂອງ ສປປ ລາວ ເປັນສາຍນ້ຳສາຂາຫຼັກຂອງແມ່ນ້ຳຂອງ, ເປັນສາຍນ້ຳໃຫຍ່ເປັນລຳດັບທີ 4 ຂອງປະເທດ
- ມີຄວາມຍາວ 354 km ມີພື້ນທີ່ຕອນໃຕ້(catchment area) 16,841 km<sup>2</sup>
- ມີອັດຕາການໄຫຼ (discharge) ລົງແມ່ນ້ຳຂອງ 21 ລ້ານ ເມັດກ້ອນ (m<sup>3</sup>), ຄິດໄລ່ເປັນ 14% ຂອງການໄຫຼທັງໝົດຂອງສາຍນ້ຳນີ້
- ມີສາຍນ້ຳຍ່ອຍ tributaries 15 ສາຍ, ສາຍຍ່ອຍຫລັກໆມີສອງສາຍຄື: ນ້ຳລິກ ແລະນ້ຳຊອງ



# A1-1. Annex

## List of Trainees: IWRM Framework 3-7/2/2014, Central Region, Vientiane Province

No	Name and Family name	Position	Organization
1	Mr. Khammoun Aakhaxay	Head of Unit	Water Resources Department
2	Ms. Chittavan Keolarsy	Technical Staff	PONRE Vientiane Capital
3	Ms. Nouphada Sengvilai	Technical Staff	NERI, MoNRE
4	Mr. Phaison Ainhanouvong	Head of Unit	NERO Thoulakom Distict, Vientiane Province
5	Mr. Kanya Sonthavisouk	Technical Staff	Department of Policy and Power Planning
6	Mr Bounthavy Muenmahasy	Head of Unit	NERO, Vang Vieng District
7	Mr. KonKham Khankham	Deputy Head Seetor	NAMSAAT, MOH
8	Mr. Doxar Boualavane	Technical Staff	Department of Irrigation, MEM
9	Mr Souliya Viengxay	Technical Staff	Head of Forestry and Water Resources NERO, Naxaithong District
10	Mr. Saylom KoumThon	Head of Unit	NERO, Kasy District
11	Mr. Thinkeo Bounmasavang	Head of Unit	PoNRE, Vientiane Province
12	Mr Souksakon PhaChonphone	Deputy Head of Unit	NERO, Keaw Udom District
13	Mr. Phouvaha LorChingkounphan	Head of Unit	NERO, Vang Vieng District
14	Mr. Simmavong Phommatham	Deputy Head of Unit	NERO, Phonehong District
15	Mr. Vonevilai Sombutmongkhoun	Head of Unit	PONRE, Bolikhamxay Province
16	Mr. Thongkhan Vongsimma	Head of Unit	NERO, Xaythany District
17	Mr. Somsanouk Vongsin	Technical Staff	NERO, LongXan District
18	Mr. Kampanath Latsavong	Technical Staff	MH
19	Mr. Pasith Vongmexay	Head of Unit	NERO, Hom District
20	Mr. Thinnakone Vongvichit	Technical Staff	NERO, Vieng Kham District
21	Mr. Khampoun Souvan	Head of Unit	NERO, Fuang District

No	Name and Family name	Position	Organization
22	Mr. SomPhone Sonvilath	Technical Staff	NERO, Xaisomboun District
23	Mr. SinXay Jonmanevong	Technical Staff	NERO, Hinherd District
24	Mr. Sakhone SyhaPanya	Technical Staff	MAF, Vangvieng District
25	Mr. Kongphaeng	Technical Staff	NERO, Parknguem District
26	Mr. Kingkham Soudsada	Technical Staff	NERO, Thaphabath District
27	Ms. Manyvane Vonmanysone	Technical Staff	DWR
28	Mr. Aitthisone Chanthavethai	Technical Staff	MAF
29	Ms. Sengchan Panyasily	Technical Staff	Component 3, NIWRMSP
30	Ms. Daophaphaone	Technical Staff	PIU 2.1
31	Mr. Sesomphaone Melattanaphaeng	Technical Staff	PIU 2.2
32	Mr. Souliya Thammalungsy	Technical Staff	DWR
33	Mr. Souksakon Phoutthaarmarth	Technical Staff	DWR
34	Mr. Souksomlane Songkham	Technical Staff	DWR
35	Mr. Singthong Phanmaly	Technical Staff	DWR
36	Mr. BounSanong Fongnaly	C1 Manager	C1 DWR
37	Mr. Khamkeng Chanthavongsa	Consultant	C1 DWR
38	Mr. Khamphone Chanthalangsy	Technical Staff	DWR
39	Mr. Viluck Duangvichit	Technical Staff	DWR
40	Ms. Sengphasouk Xayyavong	Technical Staff	DWR
41	Mr. Lattikon Xayyasane	Technical Staff	DWR
42	Mr. SomPhone KongSup	Technical Staff	PMU
43	Ms. Lammone Xayyavong	Technical Staff	PMU
44	Ms. Sengphachan Sinbandith	Technical Staff	PIU1
45	Mr Sakone Sayyasone	Technical Staff	PIU 2.1
46	Ms. Sengphasouk Xayyavong	Technical Staff	DWR
47	Mr. Lattikon Xayyasane	Technical Staff	DWR
48	Mr. Khamphone Chanthalangsy	Technical Staff	DWR
49	Mr. Singthong Phanmaly	Technical Staff	DWR



## A1-2. Annex

### List of Trainees: IWRM Framework 21-25/07/2014, Southern Region, Champasak Province

No	Name and Family name	Position	Organization
1	Mr. Sesouphun Vangthisan	Head of Unit	Irrigation Section
2	Mrs. Saphaothong Khamphapong	Deputy Head of Section	Water Resources Section
3	Mr. Somdee Sylikoun	Technical Staff	Energy and mine Department
4	Mrs. Phaymany Saikham	Head of Section	Energy and mine Department
5	Mr. Maisee Phunmalyvong	Technical Staff	Forest Resources Management Section
6	Mr. Phonexay thammavongkham	Deputy Head of Section	Water Resources Section,
7	Mr. Lerd Tavanh	Head of Forestry Section	Forestry Section,
8	Mr. Thavone Xaymongkhoun	Head of Information Section	Data & Information, PoNRE
9	Mr. phonesay Saphakdee	Head of Evaluation and Monitoring Unit	Land Management, PONRE
10	Mr. Nalinthone Chanthavilay	Head of Water Resources Section	PoNRE, Saravanh Province
11	Mr. Chaisavane Chanvankham	Technical Staff	Champasack Province
12	Mrs. Dalayphone Soulivanh	Technical staff	Water Resoures, PoNRE, Attapue Province
13	Mr. Soulidath Vanhnalay	Technical staff	Industry and commercial
14	Mr. Khamphone Chanthasy	Technical staff	Law Division, DWR
15	Mrs. Souksakhone Phouthamath	Technical staff	River Basin Division, DWR
16	Mr. Phengsavane Phedsadee	Technical Staff	Sanamxai District, Attaapua
17	Mr. Sengaloun Keokhamdee	Technical Staff	DONRE, Attapue
18	Mr. Keopasert Chanthachuk	Technical Staff	Sekong Province
19	Mr. Dednakone Prasirtkoun	Technical Staff	Karum District

No	Name and Family name	Position	Organization
20	Mr. Khamsing Syhavong	Dept. Head of Metrology Unit	Hydrology and Mythology Section
21	Mrs. Keolumphan Sydavong	Lecture	University of Champasak
22	Mr. Sithsavanh Inthavongsa	Dept. Head of Water Resources Section	Water Resources, PoNRE
23	Mrs. Xayyasith Merkvilaysane	Lecture	University of Champasak
24	Mr. Khamphet Phommavongsa	Technical Staff	Champasack
25	Mrs. Malaysouk Phommavong	Technical Staff	PoNRE
26	Mrs. Sanya Xayyavanhkham	Technical Staff	Water Resources Section
27	Mr. Bounpheng Phoulaoew	Technical Staff	Authority of Province
28	Mrs. Channaly Syvixay	Dept. Head of Section	Lao Women Union
29	Mrs. Champaphay khambuasy	Head of Unit	PoNRE
30	Mr. Bounmy Soukdavone	Technical	PoNRE, Salavanh
31	Mr. Aekaphone Soudavong	Dept. Head of Section	Information culture and tourist Department
32	Mr. Vilakhone Thongkeo	Technical Staff	Investment and Planning
33	Mr. Singthong Phantamala	Head of Ground Water Division	Water Quality Management Division
34	Mr. Viluak Doaugvichit	Technical Staff	Training and Awareness, DWR
35	Ms. Sengphachan Sinbandith	Technical Staff	C1 , DWR
36	Ms. Sengphasouk Xayavong	Technical Staff	DWR
37	Mr. Bounsanonong Fongnaly	Head of Awareness and Training Center	C1, DWR
38	Mr. Noukone Thongmany	Head of Unit	DONRE
39	Ms. Sengmany Vonghaluk	Deputy Director	Livestock and Fishery Division
40	Mrs. Vanny Sengkapkeo	Technical Officer	Fishery division, C2.3
41	Mr. Noidina Phommasay	Technical Staff	MoNRE
42	Ms. Thinphia Inthavong	Dept. Head of Unit	NUOL
43	Mr. Sengsamai Saysana	Deputy director	Public Work Section
44	Ms. Soukphasit Vongsamlan	Technical officer	PoNRE, Attapua

No	Name and Family name	Position	Organization
45	Mr. Boun Yaimany	Deputy Head of Section	Nam Saat
46	Mr. Souvanthong Manvilay	Deputy Director	Public Health
47	Mr. Sayyasit Vilavat	Deputy Director	Water Resources Sector
48	Mr. Saysana Thorlasan	Head of Unit	Environmental Sector
49	Mr. Phonepaserth Seng Vilaythong	Technical Officer	Planning and Investment Division
50	Mr. Anan	Deputy director of Land management Sector	PONRE, Land Management
51	Mrs. Bouala Sophavaly	Head of Unit	Khong District
52	Mr. Vanthaly Keopasirt	Technical Staff	MEM
53	Mr. Khamphone Chanthasy	Technical staff	Law Division, DWR
54	Mrs. Souksakhone Phouthamath	Technical staff	River Basin Division, DWR
55	Mr. Bounsanong Fongnaly	C1 Manager	DWR
56	Ms. Sangphasouk Xaiyavong	Deputy of Training and Awareness Center	DWR
57	Mr. Khamphet Keobounphun	Deputy of Division	DWR
58	Mr. Souksamlane Songkham	Technical Officer	DWR
59	Mr. Viluck Duangvichit D	Technical Officer	C1
60	Ms. Souphansa Xaysongkham	Technical officer	Training center
61	Ms. Sengphachun Sinbundid	Financial	C1
62	Mrs. Bounpheng Suvannalath	Technical Officer	DWR
63	Ms. Pingpong Boualapha	Finance	Admin Division
64	Mr. Touy Souvannalad	Technical Officer	DWR
65	Mr. Idthisone Fengphed	Technical Officer	DWR
66	Mr. Keosavane Saymongkhone	Lecturer	NUOL
67	Mr. Khamchan Xaypanyathip	Lecturer	NUOL
68	Mr. SaysamOne Dethsuvane	Technical Officer	DWR

No	Name and Family name	Position	Organization
69	Mr. Vongduen Keomounthum	Technical Officer	DWR
70	Mr. Thongchane Cheulouangkhamme	Head of Section	Luangnamtha Province
71	Mr. Setun Phenechantha	Deputy Head of Section	Luangnamtha Province
72	Mr. Khamphed Chanthavong	Deputy Head of Section	Xayyabouly Province
73	Mr. Khampasirt Phommachane	Technical Officer	Luangnamtha Province
74	Mr. Sinsakoun Xayyavong	Technical Officer	Luangnamtha Province
75	Mr. Southalid Nimmalakone	Head of Unit	Louangphabang Province
76	Mr. Siengtouy Kanlamaly	Technical Officer	Phongsaly Province
77	Mrs. Bouavanpheng Letsamee	Head of Unit	Phongsaly Province
78	Mr. Chanthachone Keosayphun	Technical Officer	Phongsaly Province
79	Mr. Khamla Insunane	Technical Officer	Xayabouly Province
80	Mr. Lud Seprasirt	Technical Officer	Houaphan Province
81	Mr. Phummexay Phengkhamhuk	Head of Unit	Houaphan Province
82	Mr. Phidsamone Philaboun	Head of Unit	Xayabouly Province
83	Mr. Khamphon Thidxayyalid	Technical Officer	Phongsaly Province
84	Mrs. Ladtaphon Sorsavane	Technical Officer	Xayabouly Province
85	Mr. Khamphone Sesoutum	Technical Officer	Vientiane Province
86	Mr. Bounleing Ainephone	Technical Officer	Vientiane Province
87	Mr. Sephun Xayyamone	Technical Officer	Oudomxay Province
88	Ms. Bouaphed Punyasith	Technical Officer	Oudomxay Province
89	Mr. Phonxay Medachid	Head of Unit	Xeingkouang Province
90	Mrs. Douangsamone Chanthavong	Technical Officer	Xeingkhouang Province
91	Mr. Khamdang Phoudthavong	Head of Unit	Oudomxay Province
92	Mr. Sonesay Oudom	Head of Section	Borkeo Province
93	Mr. Sesouphun Lorvanephai	Technical Officer	Xiengkouang Province
94	Mr. Saysavath Lattana	Head of Section	Borkeo Province



No	Name and Family name	Position	Organization
95	Mr. Thonsane Saneekone	Technical Officer	Oudomxay Province
96	Mr. Linthong Bounsavang	Technical	Xiengkouang Province

## A1-3. Annex

### List of Trainees: IWRM Framework 8-12/12/2014, Luangnamtha Province

No	Name and Family name	Position	Organization
1	Mr. Somesanith Sayyaseng	Head of Unit	Xayabouly Province
2	Mr. Maisone vongthong	Technical	Houaphan Province
3	Mr. Khamme Keochai	Driver	Phongsaly Province
4	Ms. Souphaluk Thonglyvong	Technical	Louangnamtha Province
5	Mr. Sinsakoun Phommachane	Technical	Louangnamtha Province
6	Mr. Sengphone Velaysane	Technical	Houaphane Province
7	Mr. Khammay Phommasee	Deputy Head of Unit	Houaphane Province
8	Mr. Phophed Keothavy	Technical	Louangphabang Province
9	Ms. Onchane Sechomzuen	Technical	Louangphabang Province
10	Mr. Souliyane Thummasy	Technical	Louangphabang Province
11	Mr. Vilasin Chanthaboun	Technical	Louangphabang Province
12	Mr. Thongmany Vilaykid	Technical	Louangnamtha Province
13	Mrs. Vedta Inthavysay	Technical	Louangnamtha Province
14	Ms. Daovy Keodingphun	Technical	Louangnamtha Province
15	Ms. Noy	Technical	DWR
16	Mr. ViLuck Duangvichit	Technical Officer	C1
17	Ms. Souphansa Xaysongkham	Technical officer	Training center
18	Ms. Sengphachun Sinbundid	Financial	C1
19	Mrs. Bounpheng Suvannalath	Technical officer	DWR
20	Mr. Bounsamong Fongnaly	C1 manager	C1
21	Ms. Sangphasouk Xaiyavong	Deputy of Training and Awareness Center	C1
22	Mr. Khamphet Keobounphun	Deputy of Division	DWR
23	Mr. Souksamlane Songkham	Technical Officer	DWR

## A2-1. Annex

### List of Trainees: Integrated River Basin Management and River Basin Management Plan 26-30/05/2014, Khammouan Province

No	Name and Family name	Position	Organization
1	Mr. Khammoun Ackaxay	Head of Technical Unit,	C4, NUOL
2	Mrs. Phekounthong Sindavong	Head of Section	Gnommarat District
3	Mr. Inprasith Syhalad	Technical Officer	PoNRE, Savannakhet
4	Mrs. Chittavane Keolasy	Technical Officer	PoNRE, VT capital
5	Mr. Ounhouen Xayasith	Project Coordinator	Australia Embassy
6	Mr. Somsack Manymabula	Technical Officer	Borlikhamxay Province
7	Mr.Sisomboun Vongneth	Institutional Development Specialist	Consultant
8	Mr. Chanthaphone Thammavong	Training Specialist	Consultant
9	Ms. Ounhouen Phansily	Technical Officer	Khamkeut District
10	Mr. Bounsanong Fongnaly	Component Manager	DWR
11	Mr. Lattikone Xayyasane	Technical Officer	Data and Information Center
12	Mr Vonevily Somebudnouvong	Head of Unit	PONRE, Borlikhamxay Province
13	Mr. Vangkhone Savong	Head of Unit	Pakkading District
14	Mr. Sao visay	Technical Officer	Pakkading District
15	Mr. Souphon Chitparsirt	Deputy head of Unit	Khamkeut District
16	Ms. Sengvone Lorsavane	Technical Officer	Khamkeut District
17	Mr. Valee Souvannasy	Head of Unit	Nongbok District
18	Mrs. Phoutsa Bouaphun	Technical Officer	Nongbok District
19	Mr. Semanom Keovankham	Head of Unit	Boualapha District
20	Mr. Sengmany Sengprathum	Technical Officer	Boualapha District
21	Mr. Phonsack Chitthalad	Deputy Head of Unit	Mahaxai District

No	Name and Family name	Position	Organization
22	Mr. Syprathai Phaophongsavath	Head of Section	PONRE, Khammouan Provinces
23	Mrs. Bouakeo Phounsavath	Acting Director of Division	Department of ESIA, MONRE
24	Mr. Khammanyhone Mahalad	Technical Officer	Boualapha District
25	Mr. Phunnasin Phothilad	Technical Officer	Mahaxai District
26	Mr. Vangkone Savong	Head of Unit	Pakading District
27	Mr. Dalaphone Xayyavongsa	Technical Officer	Songkhon District
28	Ms. Oudaly Sayasene	Head of Unit	Boualapha District
29	Mr. Sengdavy Vilaysack	Technical Officer	Sepon District
30	Mr. Bounsavane Saphukdy	Deputy Director of Section	Hinboun District
31	Mrs. Bounheoung Pheelabouth	Technical Officer	Xaibouathong District
32	Mr. Sengmanyvong Philavandee	Technical	Khamkeut District
33	Mr. Konkham Netthongsavane	Technical	Sepon District
34	Mr. Korlakod Suleyavong	Technical	Xaibouathong District
35	Mrs. Khaikeo Sysattanak	Technical	Mahaxai District
36	Mrs. Chomthong Ponthalid	Head of Unit	Hinboun District
37	Mr. Bounsavane Kongmany	Deputy Head of Unit	Nakay District
38	Ms. Sangphasouk Xaiyavong	Technical	C1. DWR
39	Ms. Sengphachun Sinbundid	Assistance CTA	C1, Capacity Building, DWR
40	Mr. Souksakone Phoudthaamad	Technical	River Basin Management Division, DWR
41	Mr. Souksamlan Songkham	Technical	Training and Awareness Center, DWR
42	Mr. Suparek Janprasart	CTA	C1
43	Mr. Eric Tilman	Capacity Building Specialist	C1
44	Mr. Kanalong Xaiyavong	Technical	Mahaxai District
45	Mr. Phomma Chanthabounmee	Head of Unit	Phin District



No	Name and Family name	Position	Organization
46	Mr. Thepphakone Keola	Technical	Phin District
47	Mr. Phoulatsamee Thongthipvorlavong	Head of Unit	Songkhon District
48	Mr. Hudsanai Khodsombud	Deputy Head of Unit	Songkhon District
49	Mr. Phosay Keoneth	Technical	Nong District
50	Mr. Sousada Ngaomany	Deputy Head of Unit	Nong District
51	Mr. Sephundone Sengchanthavong	Technical	Xebangfai District

# A3-1. Annex

## List of Trainees: River Basin Knowledge Development 2/9-1/10/2014, Northern and Central Regions, Vientiane Capital

No	Name and Family name	Position	Organization
1	Mr. Sinsamout Ounboundisane	Head of Office	FishBio
2	Mr. Yongthong Manyvong	Technical Officer	Division of Water Resources, XKP
3	Mr. Khamphone	Technical	DWR
4	Mr. Phaymany	Technical	DWR
5	Ms. Phetamphone Phasavath	Technical	DESIA
6	Ms. Pany Khamtachanhom	Technical	LNMCs
7	Mr. Inthanongxay	Technical	DWR
8	Ms. Phoungmala Lasany	Technical	LSB, MPI
9	Mr. Chansnith Laungvanna	Technical	Namsaat, MOH
10	Mr. Sengbandith Soudthavixay	Technical	Information Division, XKP
11	Mr. Souliya Viengxay	Technical	Namchaing Nam Soung, VTP
12	Mr. Norkham Inthapangnya	Technical	Namchaing Nam Soung, VTP
13	Mr. Doungvath Phanthachak	Head of Water resources sector	PONRE, LPB
14	Mr. Khammy Chanthaviseng	Technical Officer	Numgnum Secretariat, VTP
15	Mr. Gyonthong Keoduangdy	Technical Officer	Numgnum Secretariat, VTP
16	Mr. Khamman Thammavong	Technical Officer	Forestry Management Division, BKX
17	Mr. Silakhone Manyvone	Technical Officer	DoFRM, MoNRE
18	Mr. Sichan Chandiphit	Technical Officer	Dept Agri & Forestry, LPB
19	Mr. Soubandith Sagnaphone	Dept of Head of Water resources sector	PoNRE, LPB,
20	Mr. Khampong Thanounkeo	Technical Officer	The Asia Foundation
21	Mr. Phonesavanh Lorkhamhuang	Technical Officer	The Asia Foundation

No	Name and Family name	Position	Organization
22	Ms. Suphavanh Amphayvanh	Technical Officer	DPE, BKX
23	Mr. Chanthaphone Panyathong	Technical Officer	LPB
24	Ms. Daluny Thanongxay	Technical Officer	D of Inspection, PSL
25	Mr. Viengxay	Technical Officer	PONRE, BOKEO
26	Mr. Somemai	Technical Officer	PONRE, Phongsaly
27	Ms. Bounpheng Suvanhnalath	Technical Officer	DWR
28	Mr. Souksamlane Songkham	Technical Officer	DWR
29	Ms. Sengphachan Sinbandith	Technical Officer	DWR
30	Mr. Bounsangong Fongnaly	C1 Manger	NIWRMSP, DWR
31	Mr. Viluck Duangvichit	Technical	DWR
32	Mr. Phounmexay Phengkhamhuk	Head of Unit	Houaphan Province
33	Mr. Lud Syprasirt	Technical Officer	PoNRE, HP
34	Mr Sengsoulin Phadaungdeth	Technical Officer	Xayabouly Province
35	Mr. Sesomephet Syvelay	Technical Officer	Xeinghon Dist, Xayabouly Province
36	Mr. Boualiphan Thanalath	Technical Officer	Odomxay Province
37	Mr. Souluxay Inthalangsy	Technical Officer	Odomxay Province
38	Mr. Phearsakhit Vorlaboutda	Technical Officer	Agriculture Division, LNT
39	Mr. Sorlaphong Keomanyvong	Technical Officer	Land Allocate & Deve, LNT
40	Mr. Somsak Matsymboula	Technical Officer	PONRE, Bolikhamxay
41	Mr. Souksakhone Photthaammard	Technical Officer	DWR
42	Mr. Sakhone Xayyasone	Technical Officer	DWR
43	Ms. Latiyakhone PhomDuangdi	Technical Officer	Water Section, XK
44	Mr. Sisonelarm Chanthadeth	Technical Officer	PONRE, LPB
45	MR. Phidsamone Phelaboun	Technical Officer	PONRE, Xayaboury Province
46	Mr. Metxay Bouangern	Technical Officer	PONRE, Xayaboury Province
47	Mr. Somsanith Xayyaseng	Head of Unit	Xayaboury Province

No	Name and Family name	Position	Organization
48	Mrs. Alayavanh Lavongtheung	Technical Officer	DDMCC
49	Mr. Laolor XAISEU	Technical Officer	Oudomxay
50	Mr. Koukeo SHITALATH	Technical Officer	PoNRE, Houaphan Province
51	Mr. Khamphou Sysomphou	Head of Section	Water Resources Section, VTP
52	Mrs, Chittavane Keolasy	Technical Officer	PoNRE, HP
53	Mrs. Minavanh Douangmala	Technical Officer	DONRE, Oudomxay
54	Mr. Khamchan La	Technical Officer	Energy and Mining Division, Phongsaly
55	Mr. Phonesay Leck	Head of Water Resources Sector	PONRE, Phongsaly
56	Ms. Boua Vanpheng	Technical Officer	PONRE, Phongsaly
57	Miss Manutnay Xavongxay	Technical Officer	DFRM
58	Mr. Silixay Sisa Ad	Engineer	PONRE, Houaphan Province
59	Mr. Phaisone Phutanesi	Engineer	DEPP/MEM
60	Mr. Lattanavongsack Hooathowekham	Engineer	DEPP/MEM
61	Miss Anusone Xaisongkham	Lecturer	WRED
62	Miss Somsanook Silibounthan	Lecturer	WRED,BKX
63	Mr. Malaithong Keongothi	Technical Officer	Bokeo
64	Ms. Khamla Thammavong		DORE, VTE
65	Mr. Phonephisack Khamchantha	Engineer	NamSat, BK
66	Mr. Vilaveng Kensoulin	Technical Officer	DORE, BKX
67	Ms. Bounpheng Suvanhnalath	Technical Officer	DWR
68	Mr. Souksamlane Songkham	Technical Officer	DWR
69	Ms. Sengphachan Sinbandith	Technical Officer	DWR
70	Mr. Bounsanong Fongnaly	C1 Manager	NIWRMSP, DWR



## A3-2. Annex

### List of Trainees: River Basin Knowledge Development 13-15/10/2014, Southern Region, Khammuan Province

No	Name and Family name	Position	Organization
1	Mrs. Lamphu Boupkaisone	Deputy of Head Sector	PoNRE, Khammoune
2	Mr. Palina Khampila	Technical Staff	PoNRE, Khammoune
3	Mrs. Souphaphone Soudtharavong	Technical Staff	DWR
4	Mrs. Keomanyvone Phuthakhanty	Technical Staff	DWR
5	Mrs. Outhailath Suphantalop	Technical Staff	MONRE
6	Mr. Khatsaman Chanthalath	Technical Staff	PoNRE, Salavan Province
7	Mr. Sonexay Vongvilay	Technical Staff	PoNRE, Champasack Province
8	Mr. Siphathai Phaophongsavath	Head of Water Resources Sector	PoNRE, Khammoune Province
9	Mr. Phonexay Thammavongkham	Deputy Head of Water Resources Sector	PoNRE, Champasak Province
10	Mr. Oulaphon Ongkeo	Director of Center	NERI, MONRE
11	Mr. Sengphachan Nammavone	Deputy of Head Water Resources Sector	DTPW, Champasack Province
12	Mr. Khounta Dounglaty	Deputy of Head	DONRE, Salavan Province
13	Mrs. Veokham Oudone	Technical Staff	PoNRE, Xekong Province
14	Mrs. Lumphone Xaykosy	Technical Staff	PoNRE, Xekong Province
15	Mrs. Amphone Oudthamixay	Technical Staff	PoNRE, Savannakhet
16	Mrs. Ounta Samakee	Technical Staff	PoNRE, Attapue Province
17	Mr. Phonesavanh Lorkhamheug	Trainer	The Asia Foundation
18	Mr. Souksakhone Phutaamard	Technical Staff	DWR
19	Mrs. Bounpheng Souvanhnalath	Technical Staff	DWR
20	Mrs. NongNoud Daothong	Finance Specialist, Consultant	ADB

No	Name and Family name	Position	Organization
21	Mr. Boualumthong Ountavong	Technical Staff	Forestry Management Division
22	Mr. Nalinthone Chanthavilay	Head of Water Resource Unit	PoNRE, Salavanh Province
23	Mr. Sitsavanh Inthavongsa	Deputy Head of Sector	PoNRE, Sekong Province
24	Mr. Sasi Xayyaboud	Technical Staff	PoNRE, Savannakhet Province
25	Mrs. Phonevilay Seneboudtalath	Technical Staff	PoNRE, Savannakhet Province
26	Mrs. Keodavone Sonesaksit	Technical Staff	PoNRE, Khammoune Province
27	Mrs. Viengsavinh Joundara	Head of Water Resource Unit	PoNRE, Attapue Province
28	Mr. Ladsangkhom Chounlamany	Technical Staff	PoNRE, Attapue Province
29	Mr. Khongsavath Soundara	Technical Staff	PoNRE, Khammoune Province
30	Mr. Khampong Thanounkeo	Trainer	The Asia Foundation
31	Mr. Sinsamouth Ounboundysane	Head of office	Fishbio, The Asia Foundation
32	Ms. Nancy Kim	Country Coordinator	The Asia Foundation
33	Mr. Souksamlane Songkham	Technical Staff	DWR
34	Mr. Phonvilay Phimmasone	Technical Staff	DPEP
35	Mrs. Oudali Xayyasane	Technical Staff	Nam Saat, Center
36	Mrs. Chanthaphieng Sivongsa	Head of Unit	WQAU
37	Mrs. Kaikeo Sysatanak	Technical Staff	WQAU
38	Mrs. Phaivanh Phanhalath	Head Office	Women Union
39	Mr. Suvahndy Phetsomboun	Technical Staff	Energy and Mining Department
40	Mr. Somphuthonn Manyphone	Technical Staff	Land Management Section
41	Mr. Phonesay Thoumala	Technical Staff	DoNRE, Thakek District, Khammoune Province
42	Mr. Sounthone Laleimthavixay	Technical Staff	Agriculture and Forestry Office
43	Mr. Sayvilaysack Lathachack	Technical Staff	Public health Dept.
44	Mr. Inpheng Fongvijit	Technical Staff	Agriculture and Forestry Dept., Khammoune Province

No	Name and Family name	Position	Organization
45	Mr. Sakhone Sayasone	Technical Staff	DWR
46	Mr. Bounlammai Mali	Technical Staff	DWR
47	Mr. Inthanongsay Heuebandith	Technical Staff	DWR
48	Mrs. Sengphachan Sinbandith	Technical Staff	DWR
49	Mr. Kingkham Manivong	Head of division	Law division
50	Mrs. Sengphachan Sinbandith	Technical Staff	DWR
51	Mrs. Bounpheng Souvanhnalath	Technical Staff	DWR
52	Mr. Viluak Doaugvichit	Technical Staff	DWR
53	Mr. Souksakhone Phutaamard	Technical Staff	DWR
54	Mr. Suparerk Janprasart	CTA/Team leader	ADB
55	Mr. Bounsamong Fongnaly	Head of Awareness and Training Center	C1, DWR

## A4-1. Annex

### List of Trainees: IWRM-Ecosystem Based Approach: Exchange Visit and MONRE Demonstration Site Proposal Development 15-17/12/2015, 21-23/12/2015

No	Name and Family name	Position	Organization
1	Mr. Bounsamong Fongnaly	Director of Training and Awareness Center	DWR
2	Ms. Sangphasouk Xaiyavong	Deputy Director of Training and Awareness Center	DWR
3	Mr. souksamlane Songkham	Technical Officer	DWR
4	Mr. ViLuck Duangvichit	Technical Officer	DWR
5	Ms. Sengphachun Sinbundid	Technical Officer	DWR
6	Mrs. Bounpheng Suvannalath	Technical Officer	DWR
7	Mr. Vongsamay Lengxongpao	Head of PONRE	PoNRE Vientiane Province
8	Mr Sakone Syhapanya	Head of Unit	DoNRE Vangvieng District
9	Mr Kongpheng Khounpanya	Depty Head of Unit	DoNRE Vangvieng District
10	Mr Simmavong Phommathum	Technical	DoNRE Vangvieng District
11	Mr Bounlerd Xayavong	Head of Village	Pakpor Village
12	Mr Xayda lor	Head of Village	Nakare Village
13	Mr Sengdao Vongphachane	Head of Village	Nadoung Village
14	Mr Khamkeo Panyathip	Head of Village	Viengsamay Village
15	Mr. ViLuck Duangvichit	Technical Officer	DWR
16	Ms. Sengphachun Sinbundid	Technical Officer	DWR
17	Mrs. Bounpheng Suvannalath	Technical Officer	DWR

## A5-1. Annex

### List of Trainees: Participatory Flood Risk Management 1-4/6/2015, Xebangfai Basin, Khammoun Province

No	Name and Family name	Position	Organization
1	Mr. Latsangkom Chounlamany	Technical Staff	PONRE, Khammoun
2	Mr. Lay Thammavong	Technical Staff	Dep. of Planning and Investment, Xebangfai District
3	Mr. Meunta Xayyasone	Village Party Secretary	Napork Village
4	Mr. Duangchan Neammanivanh	Deputy Chief of the village	Napork Village
5	Mr. Vilayphone Larvivong	Chief of Village	Nayang Village
6	Mr. Yensamoune Senthanou	Deputy Head of Unit	Nayang Village
7	Mr. Bounthavy Bounthavong	Technical Staff	PONRE, Khammoun Province
8	Mr. Phonekeo Saisengsomboun	Deputy Head of Xebangfai District Office	Cabinet of Xebangfai District
9	Mr. Khanthong Xayasack	Deputy Head of Public Health Office	Public Health Office
10	Mr. Bounthan Phimphomma	Deputy Head of Public Work Office	Public Work Office
11	Ms. Sengphachan Sinbandith	Technical Staff	DWR
12	Ms. Bounpheng Souvannalath	Technical Staff	DWR
13	Mr. Somphone Khonsab	Technical Staff	DWR
14	Mr. Chanrakhone Panyanoouvong	Technical Staff	Energy and Mining, Khammoun Province
15	Mr. Saysamone	Technical Staff	DWR
16	Ms. Pingpong Boualapha	Accountant	C1, DWR
17	Mr. kalasin Inthanouvong	Lao Font Construction Committee member	Yangkham Village
18	Mr. Khamphan Vanhmixay	Chief of village	Napork Village



No	Name and Family name	Position	Organization
19	Mr. Khankeo Phetpanom	Deputy Head of Office	Information, Culture and Tourism Office
20	Mr. Khampao Hatthalath	Technical Staff	Nasaat Unit, Public Health Office
21	Mr. Sonesy Soulisack	Head of Unit	DONRE, Xebangfai District
22	Mr. Khonsy Xayyavong	Head of Section	Energy and Mining Dep. Khammoun Province
23	Mr. Siphachan Soneheunxay	Chief of Village	Hartkhamheung Village
24	Mrs. Nounta keovilay	Deputy Head of Office	Women Union, Xebangfai District
25	Mr. Keangkham Vanhnavong	Deputy Head of Office	Energy and Mining, Xebangfi District
26	Mrs. Aonta Thonkhambin	Head of Village Women Union	Yangkham Village
27	Mr. Souksamlane Songkham	Technical Staff	DWR
28	Mr. Bounsanong Fongnaly	Chief of Awareness and Training Division	C1, DWR
29	Mr. Tam Sylaphone	Technical Staff	DAFO, Xebangfai District
30	Mr. Souksakhone Phouttaamart	Technical Staff	DWR
31	Mr. Pankham Soundar	Technical Staff	NREI
32	Mr. Hongphet Souvanhno	Technical Staff	Energy and Mining, Xebangfai District
33	Mr. Homaon Xayleurdath	Technical Staff	DONRE, Xebangfai
34	Mrs. Phetsamai Innouvong	Technical Staff	DONRE, Xebangfai
35	Mr. Jaikham Xayyavong	Head of Admin. And Planning Division	PAFO, Khammoun
36	Mrs. Lettanavong Phanouvong	Lecturer	WRF, NUoL
37	Mrs. Khammuy Ketkasone	Technical Staff	DONRE, Xebangfai
38	Mrs. Banhnapha Tonkhonsavanh	Technical Staff	DONRE, Xebangfai
39	Mrs. Xaithong Keomahavong	Technical Staff	NNRBCS, C2
40	Mrs. Kongta Vanhmixay	Village Women Union	Hartkhamheang Village

No	Name and Family name	Position	Organization
41	Mr. Sonexay Sengmanivong	Technical Staff	Public Work and Transportation Dep. Khammoun Province
42	Mr. Sisaart Xayphosy	Deputy Head of Unit	DAFO, Xebangfai
43	Mr. Bounmy Thavonesouk	Technical Staff	DAFO, Xebangfai
44	Mrs. Moudmany Thammavong	Technical Staff	Public Work and Transport Office
45	Mr. Inpasith Sihalath	Head of Water Resources Unit	PONRE, Savannakhet Province
46	Mr. Somsy Phavilack	Technical Staff	PAFO, Savannakhet
47	Mr. Siphanom keovanhkham	Head of Water Resources Unit	DONRE, Boualapha District
48	Mr. Sengmany Sengphathoum	Head of Water Resources Unit	DONRE, Nongbok District
49	Mr. Phetsamoun Chanthavong	Technical Staff	DONRE, Yommalath District
50	Mr. Chansamoun Phanthalivong	Head of Water Resources Unit	DONRE, Yommalath District
51	Mr. Noumma Bhanthilath	Technical Staff	DONRE, Xebangfai District
52	Mr. Pasamith Phimmesone	Technical Staff	DONRE, Xebangfai District
53	Mr. Phonesack Siththilath	Technical Staff	DONRE, Mahaxay District
54	Mr. Kanalong Xayavong	Technical Staff	DONRE, Mahaxay District
55	Mrs. Phetmany Keovivanh	Technical Staff	DONRE, Nakai District
56	Mr. Phetnoulath Khamviphet	Technical Staff	DONRE, Nakai District
57	Mr. Seuthsomphu Siththilath	Technical Staff	DONRE, Atsaphone District
58	Mr. Vanhnakhon Duangphaya	Technical Staff	DONRE, Atsaphone District
59	Mr. Sayam Meungphudoi	Technical Staff	DONRE, Nongbok District
60	Mrs. Phus Boualaphan	Technical Staff	DONRE, Nongbok District

# A6-1. Annex

## List of Trainees: Project Cycle Management 5-7/5/2014, Vientiane Capital

No	Name and Family name	Position	Organization
1	Ms Bouangern Oudomchit	DDG	DWR
2	Mr. Lankeo Phengaloun	Head of Component	C3.2, Fishery Management, Champasak Province
3	Mr.Khamsing Sengngam	Coordinator	C3.2, Fishery Management, Champasak Province
4	Mr. Bounsangong FONGNALY	Component Manager	C1,DWR
5	Ms. Sengphasouk xaiyavong	Technical Officer	C1,DWR
6	Ms. Sengphajhun SISBANDITH	CTA Assistant	C1,Capacity Building, DWR
7	Ms. Chindavanh Souliyaphuk	PMU Assistant	PMU, DWR
8	Ms. Lummon Xaiyavong	Technical Officer	PMU, DWR
9	Mr. Oulaphone Ongkeo	Head of Component	C3, GW,NERI
10	Ms. Nouy Syvilayvong	Technical Officer	C3, GW,NERI
11	Mr. Bounyom Thummvong	Head of Component	C4, NOUL
12	Mr. Chinsamoud Keosouttha	Technical Officer	C4, NOUL
13	Ms. Soukphaphone Soudthalavong	Coordinator	C3.1.1, DWR
14	Mr Souliya Thammalasy	Technical Officer	Component 2.1: Update Water Law
15	Ms Dalounny Lilaithong	Head of Component	Component 2.1: Update Quality Monitoring & Ecosystems, NERI
16	Ms Sengchan Panyasily	Technical Officer	Component 2.1: Update Quality Monitoring & Eco-systems, NERI
17	Mr.Khamphone Chanthalongsy	Assistance	Component 2.1: Update Water Law,DWR
18	Ms. Sengmany Xayvang	Assistance	Component 2.1: Update Water Law, DWR

No	Name and Family name	Position	Organization
19	Ms. Viengthavine Chundala	Technical Officer	PONRE, Khammoune
20	Mr. Kongsavad Soundala	Technical Officer	PONRE, Khammoune
21	Mr. Vangkeo Xayphukdee	Head of Unit	PONRE, Borlikamxay Province
22	Ms. Monvilay Sombudmoonvong	Technical Officer	PONRE, Borlikamxay Province
23	Ms. Phonthip Somphonphukdee	Head of Water Resources Section	PONRE Savannakhet
24	Mr. Inpasith Syhalath	Deputy of Water Section	PONRE Savannakhet
25	Mr. Sitsavane Inthavongsa	Deputy Head of Water Resources Section	PONRE Sekong Province
26	Mr. Khanethong Thammavongsa	Technical Officer	PONRE Sekong Province
27	Mr. Asa Phunthlavong	Head of Unit	PONRE Outtappua Province
28	Ms. Dalaphone Kundavong	Technical Officer	PONRE Outtappua Province
29	Mr. Khamphou Sysomphou	Head of Water Resources Section	PONRE Vientiane Province
30	Mr. Khamphone Sichuthum	Head of Unit	PONRE Vientiane Province
31	Mr. Vueyang Yangxangyang	Deputy Head of Water Resources Section	PONRE Loungphabang Province
32	Mr. Soulasith Nummalakone	Technical Officer	PONRE Loungphabang Province
33	Mr. Phonxay Medamit	Head of Unit	PORE Xiengkouang Province
34	Ms. Douang Samone Chanthavong	Head of Unit	PORE Xiengkouang Province
35	Ms. Mounmany Keokhamde	Technical Officer	Fishery Department, MaF
36	Mr. Chitdavone Southammavong	Head of Unit	DMH, MoRE
37	Mr. Alounlat Souksavath	Technical Officer	DMH, MoRE
38	Mr. Lattikone Xayyasane	Technical Officer	Data and information Center
39	Ms. Chanlakone Homkingkeo	Technical Officer	Water Quality Management Division
40	Mr. Sisomboun Vongneth	Institutional Development Specialist	C1

No	Name and Family name	Position	Organization
41	Ms. Bounpheng Suvanhnalath	Technical Officer	DWR
42	Mr. Souksamlane Songkham	Technical Officer	DWR
43	Ms. Sengphachan Sinbandith	Technical Officer	DWR



## A7-1. Annex

### List of Trainees: Introduction to Ground Water 12-23/10/2015, 2/11/2015, National University of Laos, Faculty of Engineering and Faculty of Water Resources, Vientiane Capital

No	Name and Family name	Position	Organization
1	Mr. Oulaphone Ongkeo	C3 Manager	NREI, MoNRE
2	Dr. Keophousone Nnthalath	Lecturer	Faculty of Engineering, NUoL
3	Mr. Nick Lambert	Consultant	ADB
4	Ms. Manisakhone Chittaphong	Technical Staff	NREI, MoNRE
5	Mr. Phongsavath Yinyong	Technical Staff	NREI, MoNRE
6	Mr. Pankham Soundala	Technical Staff	NREI, MoNRE
7	Ms. Malaythong Khambounmy	Technical Staff	NREI, MoNRE
8	Mr. Sayfon Keophila	Technical Staff	NRBCS
9	Ms. Souliphone Silampheng	Technical Staff	NRBCS
10	Ms. Phouthavy Syhalath	Technical Staff	NRBCS
11	Ms. Lammon Sayavong	Technical Staff	DWR
12	Mr. Khonesavanh keovongsa	Master student	Faculty of Environmental Engineering, NUoL
13	Mr. Eakkalack Sayadeth	Technical Staff	DWR
14	Mr. Sanh Phinthongsing	Lecturer	Faculty of Environmental Engineering, NUoL
15	Mr. Fengkeo Somnilan	Lecturer	Faculty of Environmental Engineering, NUoL
16	Mr. Khaikeo Keosomphou	Lecturer	Faculty of Environmental Engineering, NUoL
17	Mr. Donlee	Student	Faculty of Environmental Engineering, NUoL
18	Mr. Khampha Syphaserth	Student	Faculty of Environmental Engineering, NUoL
19	Mr. Leupa Khamja	Student	Faculty of Environmental Engineering, NUoL

No	Name and Family name	Position	Organization
20	Mr. Phetvongkhone Luangduangsithideth	Student	Faculty of Environmental Engineering, NUoL
21	Mr. Danouphong Sinbandith	Student	Faculty of Environmental Engineering, NUoL
22	Mr. Phonesavanh Visandone	Student	Faculty of Environmental Engineering, NUoL
23	Mr. Phouthahan Inthilath	Student	Faculty of Environmental Engineering, NUoL
24	Mr. Bounchan Vongdala	Student	Faculty of Environmental Engineering, NUoL
25	Mr. Vannaeth Bouaphonenoy	Student	Faculty of Environmental Engineering, NUoL
26	Mr. Saysamone Viengvilay	Student	Faculty of Environmental Engineering, NUoL
27	Mr. Thongxay Khemvilay	Student	Faculty of Environmental Engineering, NUoL
28	Mr. Pong Syvongsa	Student	Faculty of Environmental Engineering, NUoL
29	Mr. Phickthong	Student	Faculty of Environmental Engineering, NUoL
30	Ms. Khintavanh Akkhavong	Student	Faculty of Environmental Engineering, NUoL
31	Mr. Laoya Valy	Student	Faculty of Environmental Engineering, NUoL
32	Mr. Toumaya Kheuyang	Student	Faculty of Environmental Engineering, NUoL
33	Ms. Souphaphone Keobounpheng	Student	Faculty of Environmental Engineering, NUoL
34	Ms. Vilayvanh Lianethala	Student	Faculty of Environmental Engineering, NUoL
35	Ms. Sounita Chomsilivong	Student	Faculty of Environmental Engineering, NUoL
36	Ms. Vanhsouk Pankeo	Student	Faculty of Environmental Engineering, NUoL
37	Ms. Pao Inthavong	Student	Faculty of Environmental Engineering, NUoL
38	Ms. Sommone Phothilath	Student	Faculty of Environmental Engineering, NUoL

No	Name and Family name	Position	Organization
39	Mr. Khammy	Student	Faculty of Environmental Engineering, NUoL
40	Mr. Philakhoun Lorvider	Student	Faculty of Environmental Engineering, NUoL
41	Mr. Bouaphan Sysongkham	Student	Faculty of Environmental Engineering, NUoL
42	Mr. Houseng Nengsay	Student	Faculty of Environmental Engineering, NUoL
43	Mr. Vongsaher Herchaleun	Student	Faculty of Environmental Engineering, NUoL
44	Mr. Sysamout Sysatta	Technical Staff	DWR
45	Mr. Maykham Syvongsack	Technical Staff	DWR

## Recommendations and Proposal for Following Ground Water Training

### Justification and Objectives

Training courses such as the one recently carried out showed promising results in both the performances of the students, reflected in the exam results, and the teaching staff and course content, as reflected in the students' evaluations of the course. The training increased knowledge concerning the nature of groundwater and the technologies applied in characterizing the resource and utilizing it for national development. The learning process was not restricted to university undergraduates alone, but to teaching staff as well. The attendees included three faculty members among the student participants, and the course professors as well learned from each other.

### Duration and scheduling

An ideal time for such an activity would be in the dry season, in either the first or second quarters of 2017 (the dry season of 2016 doesn't offer enough time for funding and planning).

Total course time should be 30 days interspersed within two months to allow flexibility in attendance and to slow the pace of learning of new and difficult subjects.

### Venue

Classwork can be done at the Sokpoluang campus, which is reasonably close to town, while fieldwork should be conducted at the Tadthuong campus of the faculty of water resources. Both of these venues served well during the first training session.

### Student participants

Advanced undergraduates, members of government agencies that are involved in groundwater, and NUOL faculty members should be included, but the number should be limited to around forty in total.

### Syllabus

The course content would be very similar to the one presented during the previous training with some adjustments and refinement. Introductory concepts, groundwater hydraulics, resistivity surveying, borehole drilling & pump testing, and groundwater modeling would be among the topics.

### Human Resources Required

**Lao nationals:** Four to five local experts, expected to be recruited from NUOL faculty (but may not be exclusively) would engage in the preparation and presentation of lectures and fieldwork teaching activities. Average commitment of each of these experts would be 5-7 days.

### International consultant as Project Coordinator:

This would be an international consultant with at least 10 years' experience in project management and similar work. Work Experience in Lao PDR should be a mandatory prerequisite, and proficiency in the Lao language preferred. The PC would assist in the organization and planning of the event and be present throughout as a facilitator and back-stopper. In addition to these duties, he/she would be a focal point for the initiation and administration of the Groundwater Training and Research Center. Estimated commitment would be three months - one month home office and two months on mission.

### International consultant as Hydrogeologist:

This would be an international consultant with at least 10 years' experience as a groundwater expert. Work Experience in Lao PDR should be a mandatory prerequisite, and some knowledge in the Lao language preferred, although fluency in English, both speaking and writing, would be required. Instruction in English would offer some advantages to students who may be seeking further education overseas. Preferably locally based so that scheduled missions could be flexible and help reduce traveling expenses. He/she would be expected to teach advanced subjects, such as groundwater hydraulics, pumping test analyses, and groundwater modeling. Commitment expected to be 16 days in Lao PDR: 9 days in the classroom and 7 days in the field.

### Costs (in USD)

- Project Coordinator (90 days, 60 days on mission, 30 days home office), 35,000
- International Hydrogeologist, 20,000
- Logistics (classroom rental, per diem for those outside VTE, food, transport etc), 30,000
- Allowances for Instructors (Lao Nationals) 5,000
- Borehole drilling (2 wells: one pumping well, one for observation), 15,000
- Purchase of Pumping test equipment (pump & piping, water level indicators, water quality kits), 7,000
- Contingency, 3,000

### **Total 125,000**

(cost distributed among forty students 3,125)



## A8-1. Annex

### List of Trainees: Collaborative Flood Modeling 22/6-4/7/2015, 24-26/9/2015, 9-11/10/2015, Faculty of Water Resources, NUOL, Vientiane Capital

No	Name and Family name	Position	Organization
1	Ms. Khanthamaly Sayaseng	Student	Faculty of Environmental Science, NUoL
2	Mr. Phetviengkone Onsayvieng	Lecturer	Faculty of Environmental Engineering, NUoL
3	Ms. Sounipha Xayakeo	Technical Staff	DWR
4	Mr. Lounthong Keomanykham	Technical Staff	DWR
5	Mr. Toumaya Keuyang	Student	Faculty of Environmental Science, NUoL
6	Mr. Nouyang Kaoher	Student	Faculty of Environmental Science, NUoL
7	Mr. Khammy Chanthavyseng	Technical Staff	NRBCS
8	Ms. Daovy Artkeo	Technical Staff	NRBCS
9	Mr. Lengya Valee	Student	Faculty of Environmental Science, NUoL
10	Mr. Khanphone Syhavong	Student	Faculty of Environmental Science, NUoL
11	Mr. Tom Xayalath	Student	Faculty of Environmental Science, NUoL
12	Mr. Sackda Champavong	Student	Faculty of Environmental Science, NUoL
13	Mr. Xaypaseuth Silibounphan	Lecturer	Faculty of Environmental Science, NUoL
14	Mr. Phickthong Tiengthonkham	Student	Faculty of Environmental Engineering, NUoL
15	Mr. Khounxay Phommapanya	Student	Faculty of Environmental Engineering, NUoL
16	Mr. Vilatsay lattanavong	Student	Faculty of Environmental Engineering, NUoL

No	Name and Family name	Position	Organization
17	Ms. Nouanlamay Damvongsa	Student	Faculty of Environmental Engineering, NUoL
18	Ms. Sabaiphone Sayasane	Student	Faculty of Environmental Engineering, NUoL
19	Mr. Ampho Chomxaythong	Lecturer	Faculty of Water Resources, NUoL
20	Mr. Panthong	Coordinator	NNRBCS
21	Ms. Maiphet	Technical	NNRBCS
22	Mr. Kongpaly	Technical	NNRBCS
23	Mr. Souvannavong Misi	Student	Faculty of Environmental Science, NUoL
24	Ms. Khanthamaly Xayaseng	Student	Faculty of Environmental Science, NUoL
25	Ms. Sabaiphone Sayasen	Student	Faculty of Environmental Science, NUoL
26	Ms. Nuanlamai Phouthavongsa	Student	Faculty of Environmental Science, NUoL
27	Mr. Vilatsay lattanavong	Student	Faculty of Environmental Science, NUoL
28	Mr. Assawin Insyxiengmay	Technical	DWR
29	Ms. Sounipha Xaiyakeo	Technical	DWR
30	Mr. Khammee Chanthawiseng	Technical	NNRBCS
31	Mr. Khampaseuth Vangvichith	Technical	DWR
32	Mr. Soulixay Inthasone	Lecturer	Faculty of Environmental Science, NUoL
33	Mr. Vilakone Kasioudom	Lecturer	Faculty of Water Resources, NUoL
34	Mr. Xaipaseuth Silibounthun	Lecturer	Faculty of Water Resources, NUoL
35	Mr. Bliaher Soualao	Student	Faculty of Water Resources, NUoL
36	Mr. Somphone Chansombath	Student	Faculty of Water Resources, NUoL
37	Mr. Phetviengkham Onexayvieng	Lecturer	Faculty of Water Resources, NUoL

No	Name and Family name	Position	Organization
38	Mr. Chinsamouth Keosoutha	Lecturer	Faculty of Water Resources, NUoL
39	Mr. Bounthavy Bounthavong	Technical	Khammuane
40	Mr. Nouandum Kenethavouly	Technical	DWR
41	Mr. Viluck	Technical	DWR
42	Mr. Kong Xiong	Student	WRED
43	Mr. Kaevang Xaytam	Student	WRED
44	Mr. Xayvana Manthippavong	Lecturer	Faculty of Water Resources, NUoL
45	Mr. Fengkeo Somnorvunlt	Lecturer	Faculty of Water Resources, NUoL
46	Ms. Sengphachan Keodala	Technical Officer	DWR
47	Ms. Bounpheng Souvannalath	Technical Officer	DWR
48	Mr. Leanthong Keomanykham	Technical Officer	DWR

# A9-1. Annex

## List of Trainees: Water Quality Management and Monitoring 30/6-1/7/2014, 24-25/12/2014, 17-19/6/2015, 4/8/2015, Vientiane Province

No	Name and Family name	Position	Organization
1	Mr. Thipnakone Vongvichit	Technical Staff	MoNRE
2	Mrs. Vizieng Sonthavy	Deputy Head of NREO, Viengkham VTP	MoNRE
3	Mr. Sysawad Chaiyasit	Technical Staff	Nam Ngum Dam 1
4	Mr. Shimpavhun Chaimounkhome	Deputy Head of Section	Livestock Section
5	Mr. Somly Phommachuk	Deputy Head of Authority Office	Industry Section, MIC
6	Mr. Shouksakone Phajonhpon	Deputy Head of UNIT	ESIA division
7	Mr. Somboon Phitsalart	Deputy Head of UNIT	NAMLIK Hydropower DAM
8	Mr. Thongkhome Philahvong	Deputy Head of Division	MoNRE
9	Mr Phonexay Deathavong	Head of UNIT	PONRE of VTP
10	Mr. Sang Pilahvong	Head of UNIT	MoNRE
11	Mr. Komesone Soonsavhut	Deputy Head of Division	Industry and Commerce
12	Mrs. Vilaiphone Mueagpak	Technical Staff	Lao Women Union
13	Mr. Kemkome Vhontanuvong	Deputy Head of Office	Agriculture and Forestry section
14	Mr. Phet Xaophouvong	Head of UNIT	Num Ngum 3 Hydropower Dam
15	Mr. Bounmee Koevongsa		Policy Energy Planning Department of MEN
16	Mrs. Vhunsang Kommanykoud	Technical Staff	DWR
17	Mrs. Sangparchun Sinbundit	Technical Staff	DWR

No	Name and Family name	Position	Organization
18	Mrs. Sangparchun Sinbudit	Technical Staff	DWR
19	Mr. Khampong Thanonkoe	Project Consultant	The Asia Foundation
20	Mr. Khamkieng Lakhamdy	Deputy Head office	Industry and Commerce Section
21	Mr. Phonexay Xaybounmy	Head of UNIT	Geology and Mining Section
22	Mr. Fongsamout Xayyashan	Head of UNIT	Environment Section, TV province
23	Mr. Noyladda Naowalungxy	Technical Staff	NREI, MONRE
24	Mrs. Bountavy Champa	Deputy Head of Water Resource Section	NREO, VTP
25	Mr. Phongsavhun Bunnavong	Deputy Head of House Section	PWTD, VTP
26	Mrs. Xungthong Phuntamaly	Chief and Ground Water Management Division	DWR
27	Mr. Kongphachan Deaparkoun	Deputy Head of policy Section	Energy and Mining Department
28	Mr. Souksamlan Songkham	Technical Staff	DWR
29	Mr. Kongpeng Koonphunya	Technical Staff	DONRE, Vang Vieng
30	Mrs. Viengsamai Silixay	Deputy Head of Chemical Division	FDD, MOH
31	Mrs. Khampaiy Vilaiheuang	Deputy Head of Section	DONRE, VTP
32	Mr. Vuegang Yangsienggang	Deputy Head of Section	PONRE, Luang Prabang Province
33	Mr. Soulasit Nummalakon	Technical Staff	PONRE, Luang Prabang Province
34	Mr. Khamthavy Keolaud	Technical Staff	Agriculture and Forestry, LPB
35	Mr. Nekon Vilaikaod	Head of UNIT	Energy and Mining, LPB
36	Mrs. Phonexay Milamit	Technical Staff	AF, Xiengkouang Province
37	Mrs. Keo Phanmanivong	Head of Unit	DONRE District, Xaysomboun Province
38	Mrs. Onouma Vilaysane	Head of Unit	PONRE, XSP



No	Name and Family name	Position	Organization
39	Mr. Noudeng Vongdala	Technical Officer	Department of pollution control, MoNRE
40	Mr. Kosy Simmany	Deputy Head of Unit	PONRE, Vientiane Capital
41	Mrs. Doungsamone Chanthavong	Head of Unit	PONRE Xiengkhoung Province
42	Mrs. Keomanyvhone Phouttakunti	Technical Officer	Department of Water Resources
43	Mr. Chengaloun Silaiheung	Deputy Head of Section	Vientiane Capital
44	Mr. Vongphet Soukhavongsa	Consultant	Hatfield Consult Company
45	Mrs. Chunthaly Chunthavysouk	Consultant	Hatfield Consult Company
46	Mr. Oudong Phalakone	Technical Officer	Agriculture and Forestry
47	Mr. Eric Tilman	Consultant	ADB, C1 Consultant
48	Ms. Nancy Kim	Country Coordinator	The Asia Foundation
49	Mr. Thongphet Vongkhamsook	Head of Unit	Mining, VT Province
50	Mr. Bounphun Chuntilath	Head of Section	Public Health Division
51	Ms. Trant Kim Yen	Water Quality Expert	EMSP
52	Mr. Viluk Doungvichit	Technical Officer	Training and Awareness Center, DWR
53	Mrs. Chengphasouk Xayyavong	Technical Officer	Training and Awareness Center, DWR
54	Mr. Thavone Somvong	Technical Officer	Forestry Section, Vientiane Province
55	Mr. Bounsanong Fongmaly	C1 manager	C1 DWR
56	Mr. Vhunkham Koelai	Technical Staff	Mining Section
57	Mr. Chengchun Kouthawat	Head of Unit	Engineering
58	Mr. Viengkoe Xaypukdy	Technical Staff	PONRE, BLKX Province
59	Mr. Aoulai Thammavong	Deputy Head of Section	Department of Agriculture and Forestry BLKX Province
60	Mr. Chunthakad Vilavong	Technical Staff	Energy and mining BLKX province
61	Mr. Khanchun Xainakhone	Deputy Head of Section	Agriculture Section, BLKX Province

86No	Name and Family name	Position	Organization
62	Mr. Khamphai Vilaiheuang	Deputy Head of Section	Agriculture and Forestry Section, XSB Pro
63	Mr. Sengmany Phameboun	Technical	Livestock and Fishery Department, MAF
64	Mr. Kosy Simmany	Head of Unit	PoNRE, VT Capital
65	Mr. Tinnakone Vongvichid	Technical Officer	DoNRE, Viengkham District, VTP
66	Mrs. Phouthon Phalayok	Deputy Director	Nam Lek 1-2 Hydropower Dam
67	Mr. Phoudtha Maly	Head of Unit	PoNRE, LPB
68	Mr. Bounmy Chaiyavong	Technical Officer	NERI
69	Dr. Keodoungchai Keokhamhoun	Teacher	WRED
70	Ms. Daopaky Thongsavane	Lecturer	WRED
71	Ms. Memy Khanthamaly	Lecturer	WRED
72	Mr. Thongkham Xayalad	Lecturer	WRED
73	Mr. Khaophone Syhong	Lecturer	WRED
74	Mr. Panthong	Coordinator	NNRBCS
75	Mr. Daovone Phommachane	Technical Officer	NNRBCS
76	Mr. Kanya Sengthavisouk	Engineer	DEPP
77	Mr. Boualy Meludtanapheng	Deputy Division	VT Province
78	Mr. Sengkeo Tasaked	Technical Officer	Department of Pollution Control
79	Mr. Sephai Sysengthong	Technical Officer	Agriculture and Forestry Division
80	Mr. Phonxay Medarnit	Head of Unit	Xiengkhouang Province
81	Mr. Khampheng Salyphuk	Technical Officer	VT Province
82	Mrs. Phouthong Phimbao	Technical Officer	Hom District, VTP
83	Mr. Ounheun Keophomma	Technical Officer	Hom District, VTP
84	Mr. Khemkham Vanthanouvong	Deputy Head Office	Keooudom District
85	Mr. Bounthong Vongsa	Technical Officer	Keooudom District
86	Mrs. Manyone vongsa	Technical Officer	Hinherp District

No	Name and Family name	Position	Organization
87	Mr Songmouao Xayvongpao	Technical Officer	Xaysomboun
88	Mr Inthasone Philavane	Technical Officer	Xaysomboun
89	Mr Bounthai	Director of NNRBCS	NNRBCS
90	Mr Khamla Inthasone	Technical Officer	DESIA
91	Mrs Xaythong Keomahavong	Head of Technical	NNRBCS
92	Mr Sengsoulin Outhai	Technical Officer	Planning and Cooperation, VTP
93	Mr Phongsavane Bunnavong	Head of Unit Officer	Hinherp district
94	Mr Phedphouthon Inthapudta	Technical Officer	Nam Ngum 1 Dam
95	Mr Boulieng Airniphon	Technical Officer	PoNRE, VTP
96	Mrs Vaneseng Khammanikhod	Technical Officer	Water Quality Management Division, DWR
97	Mr Chanmany Keophaivane	Technical Officer	Phonhong District
98	Mr Simphavane Xaymounkham	Deputy Head of Section	Agriculture
99	Mr Fongsamout Xayasane	Head of Unit	Environment Section
100	Mr Kongphachane Detphakhoun	Deputy Head of Section	Energy and Mining Division
101	Mrs Bounthavy Champa	Deputy Head of Section	Water Resources Section
102	Mr Xayaded Vongphukdee	Technical Officer	Viengkham District
103	Mr Phonexay Dettavong	Head of Unit	PONRE, VT Pro
104	Mrs Yenpapha Velavong	Technical	PoNRE, Borlikhamxay Province
105	Mr Sounipha Xayakeo	Technical	DWR
106	Mrs Sylephone Chanthamid	Head of Office	Keooudom District
107	Dr Vethed Syntet	Expert	EMSP
108	Assistant Professor Rachaphat	Researcher	Rajamangala University of Technology Isan, Thailand
109	Mr Souksakone Phachomphon	Head of Unit	Keooudom
110	Mr Khamkieng Lakhamdee	Deputy Office	Keooudom

No	Name and Family name	Position	Organization
111	Mr. Panthong Phetmurntham	NNRB Coordinator	NNRBCS
112	Mr. Daovone Phommachanh	NNRB Technical Officer	NNRBCS
113	Mr. Bounchanh Philavong	NNRB Technical Officer	NNRBCS
114	Mr. Khammee Chanthaviseng	NNRB Technical Officer	NNRBCS
115	Mr. Sayphonh Keophila	NNRB Technical Officer	NNRBCS
116	Ms. Khanthavy Sengvilay S	NNRB Technical Officer	NNRBCS
117	Ms. Davoy Adkeo	NNRB Technical Officer	NNRBCS
118	Ms. Kongnguern Samontee	Technical Officer	Vientiane Province
119	Ms. Phouthavy	Technical Officer	Vientiane Province
120	Ms. Latdavanh	Technical Officer	Vientiane Province
121	Ms. Souliphone	Technical Officer	Vientiane Province
122	Ms. Nalin	Technical Officer	Vientiane Province
123	Mr. Thipnakhone Vongvichit	Technical Officer	Vientiane Province
124	Mr. Santi Inthaliat	Technical Officer	Vientiane Province
125	Mr. Bounlerd Phetsoulinvongsa	Technical Officer	Vientiane Province
126	Mr. Phengdee Phengsilay	Technical Officer	Vientiane Province
127	Mr. Phommalat Souvannalay	Technical Officer	Vientiane Province
128	Mr. Phouthong	Technical Officer	Vientiane Province