



Concept Note and Program Agenda

January 22nd-24th, 2018

**Technical Training Workshop: Water Quality Impact Mitigation and Strengthening
Hydropower Cascade Dam Management for Nam Ngum River Basin, Lao PDR,**

Thalad District, Vientiane Province, Lao PDR

In partnership with

Ministry of Natural Resource and Environment (MoNRE), Ministry of Energy and Mines (MEM), Vientiane Province, Lao PDR; Ministry of Natural Resource and Environment (MonRE), Thailand; The Lower Mekong Initiative's (LMI) Sustainable Infrastructure Partnership (SIP), Pact, The Asia Foundation, SERVIR Mekong, World Bank Integrated Water Resource Mekong (IWRM) Capacity Building Program, Rachamagala University of Technical Isaan (RUTI), and Khon Khan University (KKU), Thailand

Summary

In the context of hydropower and cascade development of the Lower Mekong Region, water quality impact mitigation is one of the most critical challenges. Nam Ngum River Basin (NNRB) is located in central part of Laos and is one of the largest and most developed basins of the country and in the Lower Mekong Basin - which has hosted multiple hydropower projects, on both aspects of individual and cascade operations. Severe water pollution is one of most critical problems of the NNRB that has emerged since 2011. The problem is concentrated during the wet season in the lower part of the river across the length of 160 kilometers - where the head flows of the poor quality water are released through the NN1 and NN2 hydropower dams. The Water Quality Monitoring and Assessment Study, jointly conducted by Ministry of Natural Resources and Environment (MoNRE) and the Finish-Environmental Management Support Program (EMSP) in 2012-2015, reported that low levels of dissolved oxygen are contributing to water quality issues, caused by the intensive oxidation process of accumulative biomass due to the absence of oxygen at the bottom of the hydropower reservoirs. However, there remains a gap in comprehensive understanding on the root of the problem, and possible solutions to address the issue through technologies and management approaches are still not fully agreed upon among the responsible agencies and concerned stakeholders. There is an urgent need for consistent capacity building for and effective coordination across the key groups of stakeholders as to prepare and put in place a sustainable solution to the Nam Ngum water pollution problem.

Water quality impact mitigation and management is stated as one of the emergencies within the National Five Year Nam Ngum River Basin Management Action Plan 2016-2020. The Action Plan was prepared by Nam Ngum River Basin Committees (NNRBC) and Lao's Ministry of Natural Resources and Environment (MoNRE) through the consistent support of Australian Aid (DFAT), the Government of Spain, and the Asian Development Bank (ADB). SIP is working in close consultation with Nam Ngum River Basin Committee Secretariat (NNRBCS), MoNRE, Ministry of Mining and Mining and Energy (MEM), international aid agencies such as DFAT, US Department of State, US Department of Energy, USAID, multilateral organizations and research and development institutions such as The Asia Foundation (TAF), Institute of Water Resources Management (IWMI), Mekong SERVIR-Asian Disaster and Preparedness Center (ADPC) and international and national experts to organize and facilitate **a Technical Training Workshop on Water Quality Impact Mitigation and Strengthening Hydropower Cascade Dam Management for Nam Ngum River Basin**, planned to held on January 22nd-24th, 2018 in Thalad District, Vientiane Province, Lao PDR.

This training workshop is hoped to be the beginning of sustainable capacity building intervention on water quality impact mitigation and hydropower cascade coordination for the responsible Lao agencies, NN dam operators and concerned stakeholders. In addition, the outcomes from this intervention are intended to present a significant case study for the other Lower Mekong governments, for Friends of the Lower Mekong, and for other relevant stakeholders who are engaged in hydropower cascade research, investments and developments.

Background and Justifications:

Most hydropower dams in Lao PDR were planned and designed to generate hydro-electricity as their core function. Other types of dam usage such as for water storage, flood control and irrigation, are not considered as priorities but rather as complementary benefits. Although hydropower generation has contributed to socio-economic development in Lao PDR, there have been associated environmental and social impacts, such as increased flood risks, severe bank erosions, and poor water quality in the

downstream regions.. Multiple dams constructed and operated in the same river stretch as cascades could also magnify the adverse impacts if they are not well coordinated. Nevertheless, when adequate measures and technologies in impact mitigation and hydropower optimization are in place, these impacts could be minimized or avoided while the hydropower performance in electricity generation can be maintained or even can be improved.

Among all 62 river basins, the Nam Ngum River Basin (NNRB) is the fourth largest and one of the most developed river basins in Laos. The Basin covers 16,931 square kilometers in six provinces namely, Launghabang, Xiengkhouang, Vientiane, Vientiane City, Xaysomboun and Brolikhamxay, (*See Figure 1*). The length of the river stretch itself is 354 kilometers. The NNRB is a complex land and water ecosystem, comprising 16 sub-basins with all of its flows meeting the mainstream Mekong River, accounting for 4% of the total flows of the Mekong River Basin. The NNRB is the home of more than 850,000 people, of which the majority are working in the agricultural and subsistence farming sectors such as in rain-fed and irrigated rice farming, wild fisheries, aquaculture, livestock, and in the tourism sector. The Nam Ngum River is also one of the main water supply sources that has been fetched and used directly by rural households in the Basin, and supplied to urban areas, especially for Vientiane Capital. In line with these facts, it is undoubtable that maintaining the healthy riverine and aquatic ecosystems of the NNRB is vital for the wellbeing of the Lao people and their livelihoods.¹

The NNRB is also one of the most attractive regions for public and private investments in Lao PDR in different sectors such as in hydropower, mining industries, forestry and tourism. More than one third of irrigated areas of the country are located in NNRB. The river also offers a hydropower potential of 1,600 MW, and as such a series of large hydropower dams have been planned, constructed, and operated in the mainstream Nam Ngum River since 1968. Currently, there are already three large hydropower dams that are operational (NN1, NN2 and NN5), one is under construction and nearly complete (NN3), and one other dam has recently been approved for construction (NN4), (*See Table 1 and Figure 2*).

The operations of the NN hydropower projects have brought significant development progress and substantial revenue to the country and the Government of Laos. Giving an example from NN1, one of the very first hydropower dams in Laos has supplied the electricity to most areas of Vientiane Capital and its proximity, and has generated approximately \$36 million annually in revenue from electricity exports.

Despite the significant benefits, it is however observed that the operations of the NN cascade dams are uncoordinated and have resulted in cumulative ecosystem degradation and downstream socio-economic impacts. **Severe water pollution** is one of the critical problems of the Nam Ngum River that emerged and has been recorded since 2011. Based on data from water quality monitoring in the basin, the water pollution appears to be concentrated in the lower part of the river where NN1 and NN2 dam are located as the head flows and through the lower reach of 160 kilometers. According to the Nam Ngum River Quality 2013 report, the drop in dissolved oxygen concentration in Nam Ngum River close to NN1 reservoir began in February and reached its lowest concentration by May-June, resulting in frequent hypoxic conditions (i.e. oxygen exhaustion), which causes negative impacts on aquatic life

¹ Five Year Nam Ngum River Basin Action Plan 2016-2020

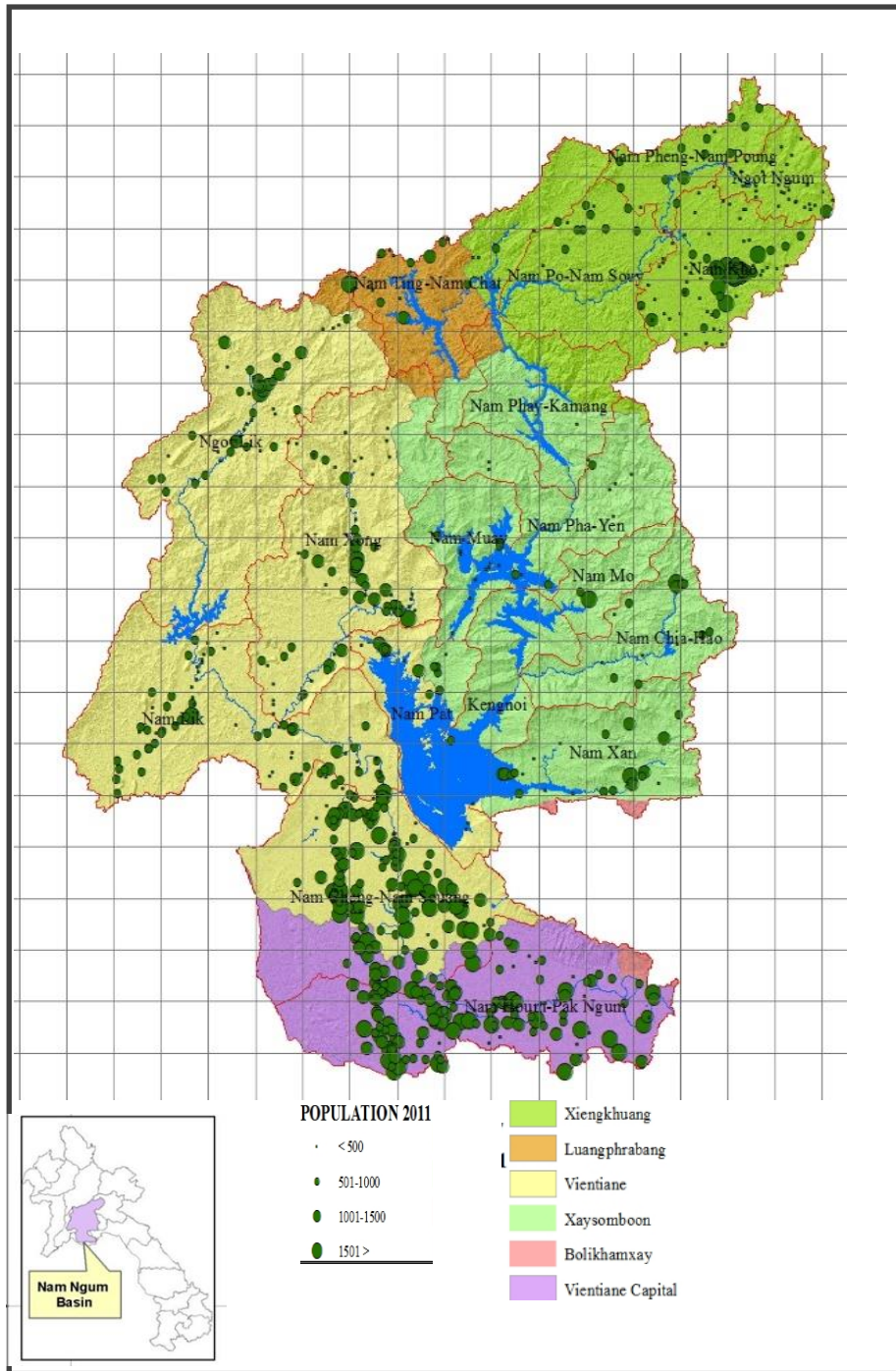


Figure 1: Administrative boundaries of the Nam Ngum River Basin. Source: ADB, IDOM, NNRBCS

Dam	Status	Year of construction	Year of operation	Installed capacity	Catchment surface area	Length/Height	Operators
NN1	Operational	1968	1971	155Mw		483m/70m	EDL-GEN
NN2	Operational	2006	2010	615Mw		485m/181m	SE Asia Energy LTD
NN3	Under construction	2011	2018	440Mw		460m/220m	NN3 Power Company
NN4	Investment plan approved	No information	No information	220Mw	No information	No information	EDL
NN5	Operational	2008	2012	120Mw		235m/104.5m	EDL & Chino Hydro

Table 1: and Figure 2: Detailed summary and a map of hydropower dams located in the mainstream Nam Ngum River.
Source: ADB, International Rivers

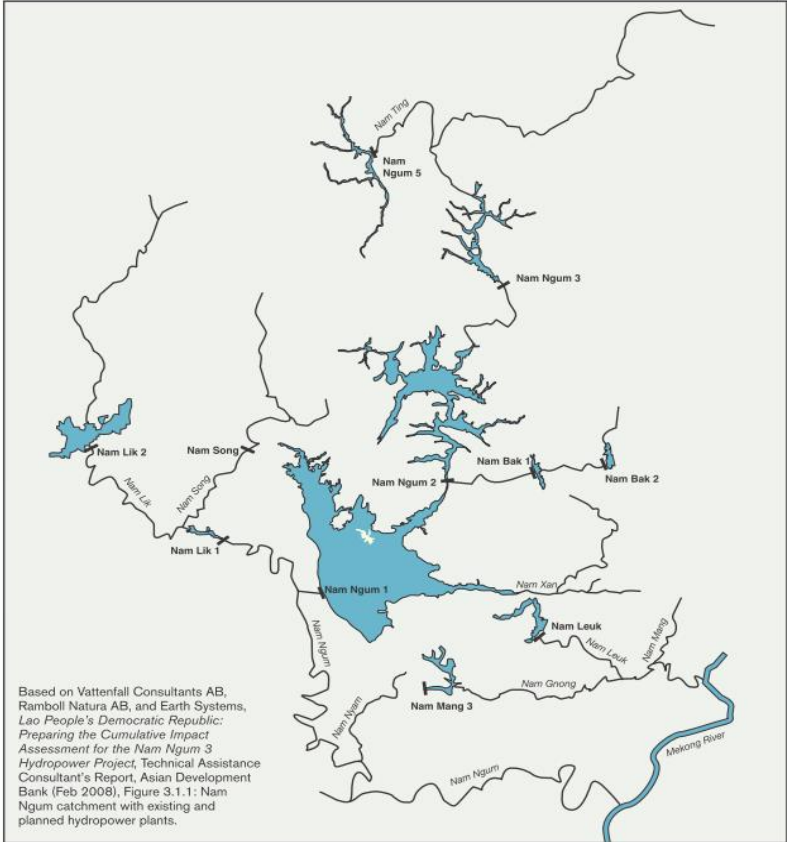




Figure 3: and 4: Blackish water in the lower part of Nam Ngum River. Photos taken in July 2017, and July 2015 respectively.

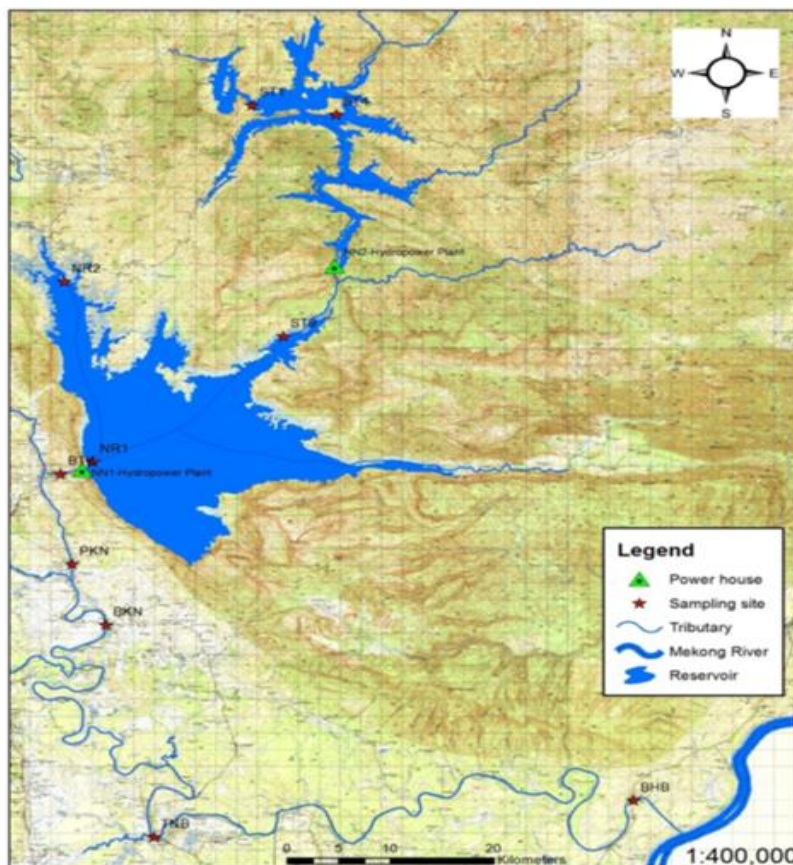


Figure 5: Sampling locations of water quality monitoring in the lower region of Nam Ngum River conducted from 2012-2015, by MONRE and EMSP.

In early years after the water pollution issues emerged, a number of potential pollution sources were identified and speculated based on the many different assumptions by different groups of key stakeholders. Very fortunately, MONRE and the Finish-Environment Management Support Program (EMSP) jointly conducted a water quality monitoring and assessment study of the Nam Ngum Basin from 2012-2015. The study was conducted through 49 water quality monitoring sampling stations across the NN River, and of that amount, 10 stations were located in the lower part of the NN River (of the 160 km length) where the water pollution was concentrated, (*See Figure 5*).

Key results of the study were concluded and summarized in bullet points as the followings.²

- The annual average value of dissolved oxygen (DO) in the water that released from the NN1 dam, from the point of water gates through the length of 160 Km, was ranging from 3-5mg/l, while the lowest international DO standard is at 6. The DO value monitored right in front of the NN1 dam gates could be found at 0 during some months of the year.
- The annual average DO value of the water mass within NN2 reservoir below the 2 meters' depth is lower than 6, and dropped sharply to 0 at the depth of 25 meters. The dam gates of the NN2 hydropower that released the flows for electricity generation is at the depth level of 55 meter.
- Location distance between the NN2 dam and the NN1 dam, which the later located downstream is approximately 30 kms. With the result, it has made become impossible for the released flows to purify or oxygenize itself within such a short distance well before it reaches and settles within the NN1 reservoir.
- The average suspended solids values from the NN2 to NN1, and then from the NN1 dam gates downstream to almost 100 kms were rather low. But in the farther downstream course became much higher. This suspected that urbanization and intensive agriculture activities were the causes. However, this result had very little connection to this poor water quality phenomenon which resulted by the deoxygenated flows released from both dams.
- A study of toxic waste and heavy metal monitoring was conducted randomly. All results came out negative and no significant trace amount of any heavy metal substances at the level that could harm humans and ecosystems were found.
- In early 2015, a brief socio-economic impact study was conducted. The result informed that the riparian communities along the NN river do not directly consume the water from the river due to the water pollution. They only used the water for domestic purposes such as floor cleaning, washing and gardening on certain occasions. Those communities have searched for different sources of water supply such as from tap water or buying from water trucks for direct consumption. Aquaculture activities in the river were heavily damaged. Fishing and harvest of riverine non-timber-forest-products were no longer continued. Market products have become the only adaptive solution for the communities resulting from such impacts.

² Nam Ngum River Quality from Upstream Reservoir from Lower Downstream Reach, Natural Resources and Environment Institute (NREI), version March 2014.

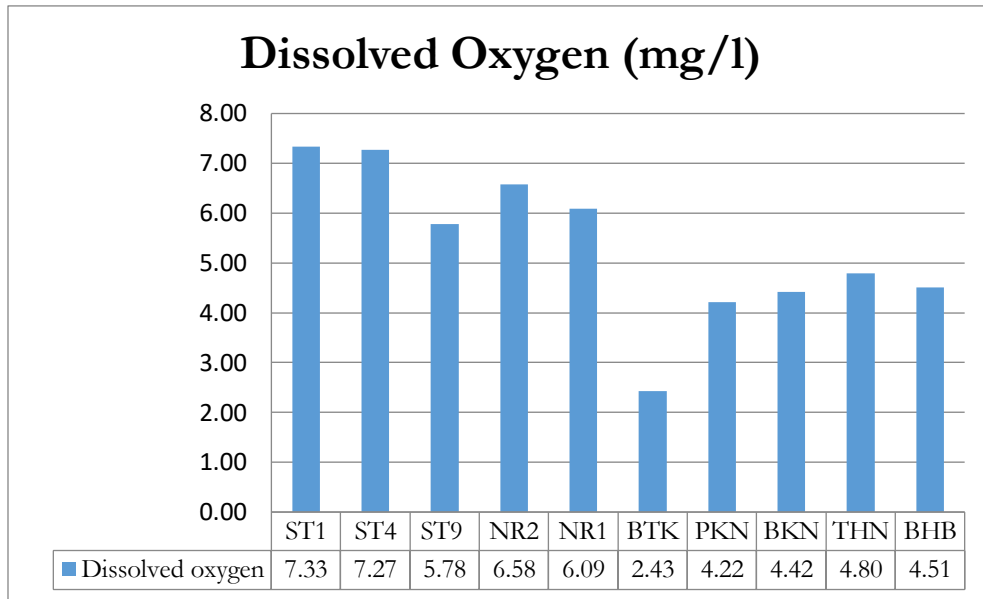


Figure 6: Spatial variations of all year round averaged dissolved oxygen values, collected from surface waters of the Lower Nam Ngum River during the years of the study.

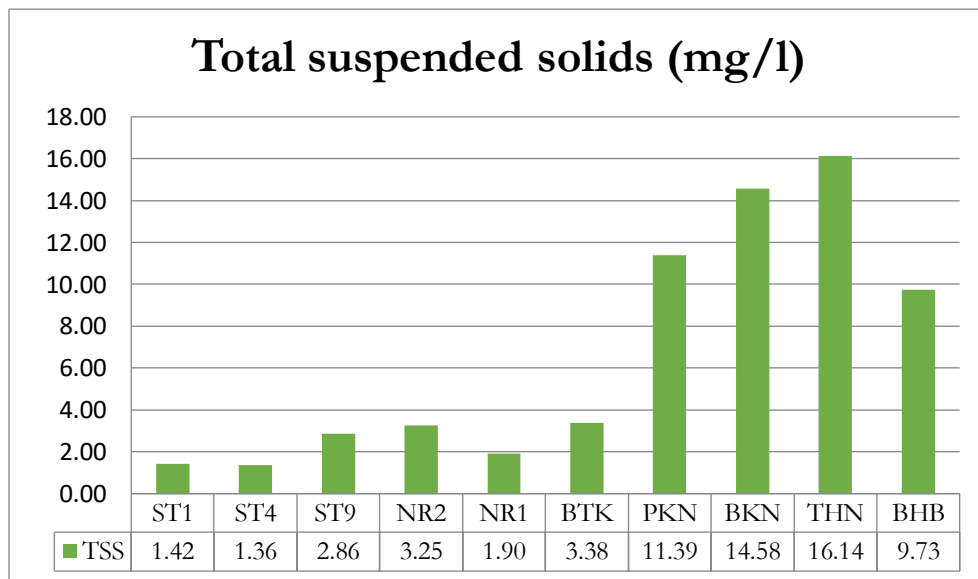


Figure 7: Spatial variations of all year round averaged suspended solids values, collected from surface waters of the Lower Nam Ngum River during the years of the study.

With the support of Australian Aid (DFAT), Asian Development Bank (ADB) and the Government of Spain, on August 4th, 2017, Nam Ngum River Basin Committee Secretariat (NNRBCS), Department of Water Resources (DWR) and Natural and Environmental Resources Institute (NERI), MoNRE organized a Consultation Meeting on Nam Ngum Water Quality Mitigation. There were more than 40 participants from different key stakeholder groups represented in the meeting that included provincial officers from the six NNRB provincial and central levels, NN1 dam and NN2 dam operators, National University of Laos, and national water and international water experts. The meeting addressed two key concerns as follows:

1. The meeting stated a very deep concern of the water quality problem in the Lower Nam Ngum River, and requested support from the concerned authorities and international aid agencies to identify possible solutions, and to organize a working group and work plan to mitigate this water pollution problem.
2. The meeting assumed that the trend of the water quality problem was likely to persist or worsen since the NN3 and NN5 dam located farther upstream were under construction and operational. The full operations of the other two more dams in the future would likely result in further aggravation of the poor water quality condition.

Given the background summarized above, SIP is working in close consultation with NNRBCS, MoNRE, MEM, international aid agencies, multilateral organizations, research institutions, development implementer organizations, and expert partners to organize and facilitate a **Technical Training Workshop on Water Quality Impact Mitigation and Strengthening Hydropower Cascade Dam Management for Nam Ngum River Basin**. This training workshop is hoped to be the beginning of a sustainable capacity building intervention on water quality impact mitigation and hydropower cascade coordination for the responsible Lao agencies, NN dam operators and concerned stakeholders. It is planned to be held on January 22nd-24th, 2018 in Thalad District, Vientiane Province., Lao PDR. The objectives and expected key outputs can be clearly identified as the following:

Objectives and Expected Key Outputs

1. Facilitate a meeting and consultation platform for the responsible agencies, dam operators, and concerned stakeholders on the water pollution problem in the Nam Ngum River Basin.
2. Develop shared understanding of the current state of the water pollution problem, and share potential solutions and successful case studies that could be adopted to mitigate the water pollution problem.
3. Facilitate a long-term approach and future work plan indicators for the responsible agencies and concerned stakeholders to coordinate, mitigate and solve the water pollution problem in the Nam Ngum River.
4. Demonstrate a training intervention that can be presented as a relevant case study for the other Lower Mekong governments, Friends of the Lower Mekong and for other stakeholders who have planned for hydropower cascade research, investments and developments.

Beneficiary and Target Groups

The training workshop will target governmental agencies and concerned stakeholders that are responsible for Nam Ngum River Basin planning and coordination, Lao official agencies on energy and mining planning and development at central and provincial levels, NN impacted stakeholder and water user groups i.e. community representatives, NN tourism promotion authority, fishery groups, Nam Ngum Hydropower Dam operators and mining companies. International organizations, university and NGOs will be invited as facilitators and observers. The training workshop will invite and accommodate up to 45 participants. An initial list of invited participants includes:

1. Six Nam Ngum provincial governors
2. Nam Ngum River Basin Committee
3. Nam Ngum Hydropower Dam Operators, NN1, NN2, NN3, and NN5.
4. Ministry of Energy and Mines, Department of Hydropower Business, Department of Energy Policy and Planning
5. Ministry of Natural Resources and Environment, Department of Water Resources, Department of Pollution Control, and National Institute of Natural Resources and Environment (NERI)
6. Ministry of Agriculture and Forestry, Department of Fisheries
7. Mining industrial companies in NNRB
8. Nam Ngum Tourism Authority
9. Vientiane Water Work Authority
10. National University of Laos
11. Selected International Organizations and NGOs
12. Friends of the Lower Mekong

Training Approaches and Methodologies

The technical training workshop will be jointly prepared and implemented with potential partners and some target groups. The training will be consisting of eight modules that are specifically tailored for the real situation of the NN water quality problem. The entire training will be conducted in interactive and participatory approaches that will lead to peaceful understanding of stakeholder' roles and responsibility, technical substances of the water quality problems in the NN river, solutions and peaceful cooperation across key stakeholder groups. All sessions will be conducted in Laos with consecutive translations offered in English on a demand basis Illustrative training module topics include:

1. Comprehensive understanding of the state of NNRB.
2. Basic technical understanding in water quality monitoring and assessment.
3. Understanding of water quality problem in the NN river from different perspectives.
4. Shared lessons learnt and successful case studies that could potentially be adopted for the case of NN water quality problem.
5. Potential technical options for mitigation and solution i.e. engineering infrastructure options, cascade dam operation and management, green infrastructure, presentation of models and simulations etc.
6. Apply a satellite imaginary technology on the water quality monitoring and assessment.
7. Study tour of the Nam Ngum 1 dam where the water quality problem is concentrated.
8. Group and plenary exercises for preparation of a long-term participatory work plan indicators for the NN water quality management.

Program Agenda

January 22nd-24th, 2018

Day 1: Monday, January 22nd, 2018

Time	Program	Facilitator
8:30-9:00	Welcome speech	Vientiane Provincial Governor/ NNRBCS / MONRE/ MEM US Government Representative
9:00-9:30	<ul style="list-style-type: none"> • Objectives of the training • Self-introduction 	SIP and partners
9:30-10:00	State of the Nam Ngum River Basin	NNRBCS
10:00-11:00	<ul style="list-style-type: none"> • Basic understanding and key terms of water quality monitoring and assessment • Summary of Water Quality Monitoring and Assessment Study in the Nam Ngum River 	MONRE and EMSP, Dr. Vithet Srinetr
11:00-11:15	Coffee break	Admin
11:15-12:30	<ul style="list-style-type: none"> • Hydropower operation, and environmental and social management of NN1 and NN2 hydropower dams • Water Quality Monitoring Reports from NN1 and NN2, (and from mining operators?) <p>Discussions</p>	NN1 and NN2 Hydropower
12:30-13:30	Lunch	Admin
13:30-13:30	Continued Questions and Answers/Discussion	SIP and Partners
14:00-15:30	<p>Successful case studies and Solution approaches</p> <ul style="list-style-type: none"> • Engineering infrastructure perspective, simulation of biomass degeneration • Impact mitigation approaches • NN Land cover changes from 2006-2016 • Community ecosystem monitoring to assess river health 	RMUTI and KKU SERVIER Mekong The Asia Foundation SIP Participants

	<ul style="list-style-type: none"> • Questions and Answers/Discussion, Plenary discussions 	
15:30-15:45	Coffee break	Admin
15:45-16:30	<p>Successful case studies and Solution approaches</p> <ul style="list-style-type: none"> • Engineering infrastructure perspective, simulation of biomass degeneration • Impact mitigation approaches • NN Land cover changes from 2006-2016 • Water quality monitoring by network of communities 	<p>RMUTI and KKU</p> <p>SERVIER Mekong</p> <p>The Asia Foundation</p> <p>SIP</p> <p>Participants</p>

Day 2; Tue, January 23rd, 2018

Time	Program	Facilitator
8:30-9:00	Recap from Day 1	NNRBCS
9:00-10:00	Continued Question and Answers/ Discussion from Day 1	SIP RMUTI and KKU The Asia Foundation SERVIR Mekong
10:00-11:00	Small group exercise on next step and long-term action plans	SIP and partners
11:00-11:15	Coffee break	Admin
11:15-12:00	Small group exercise on next step and long-term action plans	SIP and partners
12:00-13:00	Lunch at Van Vieng	Admin
13:00-16:30	Field trip at Nam Ngum 1 Dam/Water Quality Monitoring Samplings	NNRBCS/NN1

Day 3: , Wednesday, January 24th, 2018

Time	Program	Facilitator
8:30-9:00	Recap from Day 2	NNRBCS
09:00-10:00	Continued Small Group Exercise	SIP and Partners
11:00-11:15	Coffee break	Admin
10:00-12:00	<ul style="list-style-type: none">• Plenary presentation and discussion• Initial Agreement on Next Steps and Long-term Work Plan on Nam Ngum Water Pollution Management	NNRBCS/SIP and Partners
12:00-12:30	<ul style="list-style-type: none">• Conclusion• Closing	Vientiane Provincial Governor/ NNRBCS / MONRE/ MEM US Government Representative
12:30-13:30	Lunch	Admin
13:30	Travel back	Admin