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## **The Council Study**

**Study on the sustainable management and development of the Mekong River,  
including impacts of mainstream hydropower projects**

### **Work Plan: Formulation of Development Scenarios for the Domestic and Industrial Water Use Thematic Area**

This work plan describes the roadmap and the approach for formulating the development scenarios for the domestic and industrial water use thematic area. It includes the following:

- Approved Cumulative Scenarios (2007 Early Development, 2020 DFS, 2040 Planned Development) and Proposed Thematic Sub-scenarios;
- Detailed schedule of data collection and analysis including coordination with Member Countries through consultation with appropriate experts of line agencies, national consultations, and regional technical working group;
- Detailed data needs including current status, source agencies, and known issues for each proposed development scenario ;
- Proposed methodology and assumptions to fill data gaps in particular where data are known to be not available; and
- Personnel roles and responsibilities.

*Prepared by:*

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Document History

Version	Revision	Description	Issued Date	Issued by
1	0		9 June 2015	Dararath
2	1	Adjust the development sub-scenarios for the Domestic and Industrial Water Use	13 July 2015	Dararath
3	2	Adjust the development sub-scenarios for the Domestic and Industrial Water Use	20 July 2015	Henry Dararath

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## Contents

1.	Introduction .....	4
2.	Development Scenarios .....	5
2.1	Cumulative Scenarios .....	5
2.2	Thematic Sub-Scenarios .....	6
2.3	Proposed Thematic Sub-Scenarios for the Domestic and Industrial Water Use Thematic Area .....	6
3.	Data Requirements .....	8
4.	Handling of Data Gaps.....	9
5.	Detailed Schedule .....	10
6.	Personnel Roles and Responsibilities .....	12

## 1. Introduction

This work plan describes the roadmap and the approach for the formulation of the development scenarios that are going to be assessed under the Council Study. The results of these development scenario assessments will be used as the primary basis to address the overall objective of the Council Study which is to further enhance the ability of the Mekong River Commission (MRC) to advise Member Countries (MCs) on the positive and negative impacts of water resources development on people, economies and the environment of the Mekong River Basin. This enhanced ability is expected as a result of meeting the following specific objectives of the Council Study:

- Objective 1:** Further develop/establish a reliable scientific evidence base on the environment, social and economic consequences (positive and negative) of development in the Mekong River Basin.
- Objective 2:** Results of the study are integrated into the MRC knowledge base to enhance the Basin Development Planning (BDP) process providing support to the MCs in the sustainable management and development of the Mekong River Basin.
- Objective 3:** Promote capacity and ensure technology transfer to MCs in the process of designing and conducting of the study.

As such, the formulation of development scenarios is most critical since it defines the extent to which these three objectives can be met. The formulated development scenarios will set the boundary for what new knowledge will be generated, what knowledge gaps will be closed, and what uncertainties in the assessments will be minimized (i.e., Objective 1). The assessment methodology and the associated tools (both existing and new) along with the expanded MRC knowledge base will determine the extent of how the current BDP process can be enhanced (i.e., Objective 2). The participatory process adopted in formulating the development scenarios will govern how effective the learning-by-doing approach is with respect to building internal capacity and successfully transferring technology (i.e., Objective 3).

As per the Council Study Concept Note, Terms of Reference (TOR) and Inception Report, the assessments will include the following types:

- An assessment of the cumulative positive and negative impacts of water resource developments in all six selected thematic areas on the triple-bottom-line including clear indications of hotspots when/if relevant, and the thresholds of rapid transition—tipping points—in complex systems such as the Tonle Sap Lake in Cambodia and the Mekong Delta in Cambodia and Viet Nam (i.e., referred hereinafter as the assessment of **cumulative development scenarios**).
- Assessments for each thematic area summarising the transboundary impacts of developments in the selected thematic areas including cross-cutting impacts on the triple-bottom-line: the environmental, social and economic parameters of interest in the Mekong River Basin (i.e., referred hereinafter as the assessment of thematic development sub-scenarios).

In the end, the Council Study will produce a set of clear, strategic, pragmatic and actionable recommendations directly addressing potential uncertainties, risks and the information needs for development planning in the mainstream of the Lower Mekong Basin (LMB), including recommendations for impact avoidance and mitigation measures.

## 2. Development Scenarios

The development scenarios will be formulated by defining levels of developments in six thematic areas for each scenario. The six thematic areas are:

- Irrigation; including water use, return flows, water quality, proposed diversions, etc.
- Agriculture and Land use, including watershed management, deforestation, livestock and aquaculture, fisheries etc.
- Domestic and Industrial use, including mining, sediment extraction, waste water disposal, urban development, water quality etc.
- Flood protection structures and floodplain infrastructure, including roads on major floodplains
- Hydropower, including potential of alternative energy options
- Navigation, specifically on infrastructure to aid navigation

The development scenarios will be of two types namely cumulative development scenarios and thematic sub-scenarios.

### 2.1 Cumulative Scenarios

The cumulative scenarios are based on historic (2007) and planned (2020 and 2040) basin-wide developments in the six thematic areas. These cumulative scenarios will allow the assessment of cumulative positive and negative environmental and socio-economic impacts associated with planned developments by the MCs. The assessment will show the predicted changes in the environmental and socio-economic conditions in the LMB in space and time and potentially reveal clear indications of geographic hotspots and rapid transitions in time as a result of combined developments in the six thematic areas. Along with the results of the assessment of selected thematic sub-scenarios under which impacts of specific-thematic developments can be better understood, realistic, reasonable, and thus actionable development options and management measures can be identified to enhance positive impacts and minimize negative impacts of the planned developments. Strategic measures for long-term negative impact avoidance and risk mitigation can also be identified for development planning considerations by the MCs.

During the 4<sup>th</sup> RTWG Meeting, the following cumulative development scenarios were approved for the Council Study.

Early Development Scenario/Situation (2007): This scenario covers the period from the beginning of large-scale water resources development until the year 2007 when the flow regime of the Mekong mainstream was considered to be still in its natural state. This scenario includes the water infrastructure and the land use/cover changes in in the six thematic areas by 2007.

Definite Future Scenario (2020): This scenario includes all existing (before and after 2007), undergoing construction, and firmly committed development infrastructure in the six thematic areas which are expected to be in place by 2020.

Planned Development Scenario (2040): This scenario includes all water resources development that is planned in the six thematic areas in the Mekong Basin and are expected to be in place by 2040 assuming these plans are fully implemented.

## **2.2 Thematic Sub-Scenarios**

The Thematic Sub-Scenarios represent plausible thematic-specific deviations from the 2040 Planned Development Scenario. These thematic-specific deviations reflect level of uncertainties in the full implementation of the planned development level for the thematic area of interest as per the 2040 Planned Scenarios. These deviations can be due to several factors such as changes in national development policies and priorities, technology, demography, socio-economic conditions, global context, etc. The deviations are formulated around the 2040 Planned Scenario to keep these thematic sub-scenarios plausible. It should be noted that while a different level of development is used for the thematic area of interest, the levels of development for the other thematic areas are held equal to the planned 2040 levels.

The assessment of these thematic sub-scenarios will provide the following understanding:

- Sensitivity of impacts to deviations from planned development levels;
- Better understanding of impacts of specific development stressors (i.e. closing knowledge gaps);
- In-depth analysis of the plans and plausible deviations in the plans (i.e. understand uncertainty in the plans and identify measure to minimize deviations); and
- Increase understanding and capability to explore options and measures to enhance positive impacts and mitigate/reduce negative impacts.

As per the Inception Report, a maximum of three thematic sub-scenarios per thematic area will be assessed. However, the Thematic Team may identify more than three potential thematic sub-scenarios. These thematic sub-scenarios will be presented to the MCs to get their input and final concurrence on what thematic sub-scenarios to assess.

## **2.3 Proposed Thematic Sub-Scenarios for the Domestic and Industrial Water Use Thematic Area**

Planned Development Scenario 2020 and 2040 in Domestic and Industrial Water Use Thematic Area includes the water resources development in 2020 and 2040. The Domestic and Industrial Water Use will cover the following sub-sectors:

- Domestic water supply;
- Industrial development and water consumption; and
- Sand Extraction.

The Domestic and Industrial Water Use will include all water resources development in relation to the above mentioned sub-sectors that has been planned, including feasibly specific plans and visions or development directions up to 2020 and 2040.

The development sub-scenarios of the Domestic and Industrial Water Use represent plausible thematic-specific deviation from the 2040 Planned Development Scenario. The deviations demonstrate uncertainties that may take place during the full implementation of the planned development up to 2040.

Major factors affecting the development sub-scenarios of the Domestic Water Use include changes in hydrological condition, multi-sector water demands and/or proposed interventions, changes in population, expansion of urban development areas, and socio-economic condition. Main factors affecting the development sub-scenarios of the Industrial Water Use consists of increase in industrial areas/zones, increase in size of industry, increase in areas of sand extraction, changes in technology, and socio-economic conditions. Changes in national and regional policies as well as priorities can also affect the development sub-scenarios of the Domestic and Industrial Water Use.

Example of the estimated present and future domestic water demand per capita based on the changes in population of each Member Countries is shown in Table 2. The estimate of the population is also presented in Table 1.

**Table 1: Estimated populations in Basin (million)**

Country	2000 <sup>(1)</sup>	2007 <sup>(2)</sup>	2014 <sup>(3)</sup>	2020 <sup>(4)</sup>	2040 <sup>(4)</sup>
Cambodia	12.2	14.4	15.4	18.1	23.1
Lao PDR	5.4	5.9	6.9	7.2	8.8
Thailand	62.3	63.9	67.2	68.0	68.9
Viet Nam	80.9	87.4	92.5	101.7	116.7

Source:

- (1) UNESCAP, Statistical yearbook for Asia and the Pacific 2013
- (2) MRC, State of the basin report 2010
- (3) United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014 Revision
- (4) United Nations, Department of Economic and Social Affairs, Population Division (2007). World Urbanization Prospects: The 2007 Revision

**Table 2: Estimated domestic water demands**

Country	Average per capita use (l/day)								
	2000	2007		2014		2020 <sup>(*)</sup>		2040 <sup>(*)</sup>	
		Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Cambodia	32	130	90	124	91	175	81	266	63
Lao PDR	64	180	60	221	54	257	49	353	34
Thailand	115	170	170	260	128	207	153	281	118
Viet Nam	67	100	60	118	56	124	54	176	42

Note: (\*) projected data

Sources:

- Lao PDR-Water Supply Authority (WASA)
- Thailand-Provincial Waterworks Authority
- Cambodia-Capacity Building for Water Supply System in Cambodia Phase 2
- Viet Nam-Country verification

According to the UNESCAP (2013), the total water withdrawal of the industrial sector was approximately 1.5% (2006), 4.9% (2005), 4.8% (2007), and 3.7% (2005) of the total water withdrawal for Cambodia, Lao PDR, Thailand and Viet Nam, respectively.

According to study by EchoGeo<sup>1</sup> (2013), a total volume of 34.48 million cubic metres (55.2 million tons, density of 1.6 ton per cubic metre of dry sand) of sediment were extracted from the Mekong mainstream in Lao PDR, Thailand, Cambodia, and Viet Nam in 2011. Of which, approximately 90% (49.68 million tons) of the total bulk on average could be considered as sand. The map indicating the extraction sites along the Mekong River is presented in **Error! Reference source not found.** A conservative estimate of sand in suspension and sand transiting as bed load could add 10 to 30 million tons to the common estimate of 145 to 160 million tons of suspended sediment. If the conservative figure of 56 to 57 million tons of extracted sediment per year is accepted, then to what extent is sediment discharge affected? A study has indicated that the sand extraction activity can result in significant incision and bank erosion in the Mainstream of the Mekong River.

The sub-scenarios of the domestic and industrial water use are presented as plausible outcomes of the planned development due to varying levels of implementation. Three development sub-scenarios are identified to illustrate these likely outcomes, including the driving forces and trends that can affect the level of implementation of the development plans.

Sub-scenario 1: Low Development – This sub-scenario takes into account only specific plans are implemented.

Sub-scenario 2: Medium Development – This sub-scenario takes into account not only the specific plans but also vision/strategic development directions are implemented.

Sub-scenario 3: High Development – This sub-scenario also include other development potentials in addition to the implementation of specific plans, and vision/strategic development directions.

When developing the sub-scenarios, the levels of development can be varied for each sub-sector. For example, a sub-scenario may represent a low development level for the domestic water use, medium development level for the industrial water use, and high development level for sand extraction industry. However, because of the limited number of sub-scenarios (i.e., maximum of three) that can be assessed for the domestic and industrial water use thematic area, it is most likely that each sub-scenario will represent the same level of developments for all sub-sectors of this thematic area (i.e., a sub-scenario may represent low development level all subsectors: domestic water use, industrial water use, and sand extraction industry).

### 3. Data Requirements

The data requirements are presented in the below table:

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<sup>1</sup> A paper on Geography of sand and gravel mining in the Lower Mekong River (First survey and impact assessment) was published by EchoGeo in 2013. The authors were Jean-Paul Bravard, Marc Goichot and Stephane Gaillot.



Data required (different for each scenario)	Current Status (2007, 2020, and 2040 scenarios)	MC Line Agencies to Contact
<ul style="list-style-type: none"> <li>Population for each country</li> </ul>	Available in MRC (BDP)	
<ul style="list-style-type: none"> <li>Population access to domestic water supply</li> </ul>		Municipality
<ul style="list-style-type: none"> <li>National plans for expansion of the domestic water supply</li> </ul>		Municipality
<ul style="list-style-type: none"> <li>Inventory of the locations, sizes, and types of large industries</li> </ul>		<ul style="list-style-type: none"> <li>Ministry of Industry and Mines (Cambodia)</li> <li>Ministry of Industry and Commerce &amp; Ministry of Energy and Mine (Laos)</li> <li>Ministry of Industry (Thailand)</li> <li>Ministry of Industry and Trade (Viet Nam)</li> </ul>
<ul style="list-style-type: none"> <li>Output production of these industries</li> </ul>		<ul style="list-style-type: none"> <li>Ministry of Industry and Mines (Cambodia)</li> <li>Ministry of Industry and Commerce &amp; Ministry of Energy and Mine (Laos)</li> <li>Ministry of Industry (Thailand)</li> <li>Ministry of Industry and Trade (Viet Nam)</li> </ul>
<ul style="list-style-type: none"> <li>Relation between outputs, types of industry and water use (based on international guidelines), which can support an alternative methodology for estimating industrial water demand</li> </ul>		
<ul style="list-style-type: none"> <li>Locations of existing and potential sites for sand extraction along the Mekong</li> </ul>		<ul style="list-style-type: none"> <li>Ministry of Industry and Mines (Cambodia)</li> <li>Ministry of Industry and Commerce &amp; Ministry of Energy and Mine (Laos)</li> <li>Ministry of Industry (Thailand)</li> <li>Ministry of Industry and Trade (Viet Nam)</li> </ul>
<ul style="list-style-type: none"> <li>Volume of sand extraction per year (m<sup>3</sup>/year)</li> </ul>		<ul style="list-style-type: none"> <li>Ministry of Industry and Mines (Cambodia)</li> <li>Ministry of Industry and Commerce &amp; Ministry of Energy and Mine (Laos)</li> <li>Ministry of Industry (Thailand)</li> <li>Ministry of Industry and Trade (Viet Nam)</li> </ul>

#### 4. Handling of Data Gaps

Most of the data and information are not available in MRC; therefore, there is a need to get the national consultants involved in the data and information collection regarding the National Domestic Water Use and Supply, National Industrial Development Plan, National Industrial Water Use and Supply. The roles and responsibilities of the national consultants are clearly defined in the TOR for the national consultant.

## 5. Detailed Schedule

The table below shows the proposed detailed schedule for formulating the development scenarios for the Domestic and Industrial Water Use Thematic Team. The proposed schedule follows the overall common schedule shown in the below Table.

Activity	Responsible by	Due Date	Progress	Challenges
1. Recruit international and national consultants	Dararath	3 June 2015	Completed The evaluation report has already submitted to HR for contracting the individual consultant	
2. Revise and re-submit Draft Work Plan for the Formulation of Development Scenarios to CS Coordinator	Dararath	10 June 2015	Submitted on 13 July 2015	
3. Submit Final Draft Work Plan to CS Coordinator	Dararath	12 June 2015		
4. Get the international and national consultants on-board	HR	20 July 2015		
5. Conduct technical meeting with the international and national consultants to discuss the detailed work plan and draft formulation of development scenarios	Dararath, Duyen, & all consultants	28 July 2015		
6. Compile all relevant needed information and data	National Consultant	6-31 July 2015		
7. Follow-up with line agencies in collecting data and conducting small group technical consultations with appropriate experts	Dararath/ National Consultants	6-31 July 2015		

Activity	Responsible by	Due Date	Progress	Challenges
from line agencies				
8. Conduct remaining data processing and analysis including identification of remaining data gaps and formulation of thematic sub-scenarios	Dararath	27 July – 31 July		
9. Submit a 1 <sup>st</sup> draft report to be discussed at the National Consultation Workshop	Dararath/ International Consultant / National Consultants	20 August 2015		
10. Conduct National Consultation Workshops	Dararath/Du yen	20 August – 18 September 2015		
11. Conduct final data collection, data gap filling and analysis and submit Development Scenarios/Sub-scenarios Data/Map Specification Document to CS Coordinator	Thematic Teams	18-30 September 2015		
12. Draft Formulated Development Scenarios (Data and Technical Document Describing Scenarios)		2/10/2015		
13. Final Draft Formulated Development Scenarios (Data and Technical Document)		19/10/2015	To be presented for approval by RTWG during the 6th RTWG meeting	

The successful implementation of this work pan requires the international and national consultants to be on board as per schedule.

## 6. Personnel Roles and Responsibilities

The Domestic and Industrial Water Use Thematic Team will include the following key personnel with their roles and responsibilities as following:

EP Programme Coordinator (Van Duyen Nguyen) is responsible for overall supervising the Domestic and Industrial Water Use Thematic Area Team.

Environment Management Specialist (Dararath Yem) is responsible for immediately supervising international and national consultants for ensuring effective communication among the team and review all technical outputs and deliverables delivered by the consultants.

International Consultant is primarily responsible in completing the outputs and deliverables of this thematic study on schedule. The detailed roles and responsibilities of the international consultant are elaborated in the TOR for the international consultant.

National Consultants (one from each Member Country) is responsible for providing technical support for the preparation of development scenarios and providing inputs to the thematic report. The areas of work contribution include providing national/regional knowledge, the collection and compilation of data needed for the development of the scenarios and impact analysis. The detailed roles and responsibilities of the national consultant are elaborated in the TOR for the national consultant.