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The Council Study

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

Technical Working Paper: Thematic Data and Map Specifications Document - Agriculture and Land Use Change

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1 Introduction

This working paper 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.

Within Council Study, Agriculture and Land use change thematic Study focuses on agriculture development and land use change. The main objective of the Study is to further enhance the understanding of the negative and positive impacts of water resources development in the agriculture and land use sector on water resources, people, economies, and the environment of the Lower Mekong River Basin. This study will fill knowledge gaps and reduce the uncertainty in estimating these impacts, providing the Member Countries with higher confidence information towards informed decision-making.

2 Baseline and 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.

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 4th 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 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.

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)
- 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.

3 Agriculture and Land Use Change

3.1 Approach and process of data collection/compilation

This paragraph describes the approach followed to collect the necessary information to develop the different scenarios. Under the supervision and coordination of the Agriculture and Irrigation Team, the members of national teams (National coordinators, National Consultants, etc) have participated to various workshops and formal and informal meetings. Out of the coordination meetings a straight coordination and communication process was continuously held by emails and regular exchange.

The different steps are described in the next paragraphs.

3.1.1 Preparation of scenario formulation methodology

Based on the terms of reference and the guidelines highlighted in the inception report, the Agriculture and Irrigation Team has drafted a first methodology for the scenario formulation.

The work plan describes the roadmap and the approach for formulating the development scenarios for the Agriculture and Land Use Change 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
- Personnel roles and responsibilities

3.1.2 Presentation and discussion of the methodology and data to be collected

The document was shared with the national consultants and the national coordinators prior to the *Meeting on the scenario development*. This allowed each participant to take note of the methodology proposed and prepare the discussions during the meeting.

A full day meeting was organized where the International consultant has presented the methodology proposed. The presentations were focusing on:

- A shared vision of the process of the development of the Agriculture and Land Use Change thematic area
- Which drivers are to be considered for the development of the scenarios?
- Which data should be collected to develop the scenarios?
- Explanation of the timelines to be considered for the purpose of the Council Study
- Explanation of the concept of sub scenario

The methodology proposed for the formulation of the development scenario is organized around the following activities that are to be conducted by the national consultants:

- [Access data on existing & planned agriculture and land use change schemes](#)

At the country level, the national consultant must collect the necessary data that illustrates the current status and the future strategy for the agriculture and land use change. Based on the organization of the sector for each of the four member countries, the national consultant should access:

- The reports and / or databases that describe the current agriculture and land use change. This activity will lead to the description of the Early Development scenario that has led to the situation in 2007.
- The documents that describe the development strategies at the national, regional, provincial or (sub)basin level for the future time horizons. The purpose of the activity is to highlight the trends and objectives of the sector development at the country level, with a particular emphasis on the LMB. This activity will lead to the description of the Definite Future Scenario (2020) and the Planned Development Scenario (2040).

The following tables show summary are of rainfed agriculture and other land use area in 2007 and scenario 2020 and 2040, respectively.

Summary table of current agriculture and land use				
2007				
	Cambodia	Lao PDR	Thailand	Viet Nam
Rainfed agriculture (ha)	82,059	861,920	3,279,182	322,556
Forest (ha)	462,769	9,552,425	1,914,286	2,868,708
Surface mining (ha)	47,977	323,114	1,214	132,080

Summary table of scenarios for agriculture and land use				
Cambodia	2020		2040	
	ha	% increase from 2007	ha	% increase from 2007
Rainfed agriculture	404,500	393%	462,754	464%
Forest	462,769	0%	462,769	0%
Surface mining	47,977	0%	47,977	0%

Summary table of scenarios for agriculture and land use				
Lao PDR	2020		2040	
	ha	% increase from 2007	ha	% increase from 2007
Rainfed agriculture	1,322,724	53%	1,892,179	120%
Forest	9,552,425	0%	10,427,122	9%
Surface mining	70,629		3,279,749	

Summary table of scenarios for agriculture and land use				
Thailand	2020		2040	
	ha	% increase from 2007	ha	% increase from 2007
Rainfed agriculture	3,273,538	0%	3,259,941	-1%
Forest	1,922,993	0%	1,928,797	1%
Surface mining	864	-29%	ND	

Summary table of scenarios for agriculture and land use				
Viet Nam	2020		2040	
	ha	% increase from 2007	ha	% increase from 2007
Rainfed agriculture	358,783	11%	ND	
Forest	2,733,780	-5%	2,760,271	-4%
Surface mining	175,080	33%	173,982	32%

The rain-fed agriculture in Cambodia is projected to significantly increase in 2020 and in 2040 as Cambodia has larger potential of agricultural development and development policy. The rain-fed agriculture in Lao PDR is also projected to increase in 2020 and in 2040. On the other hand, the rain-fed agriculture in Thailand and in Viet Nam are not projected to increase.

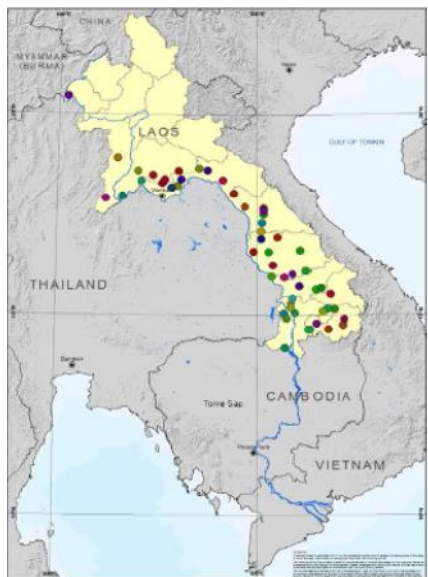
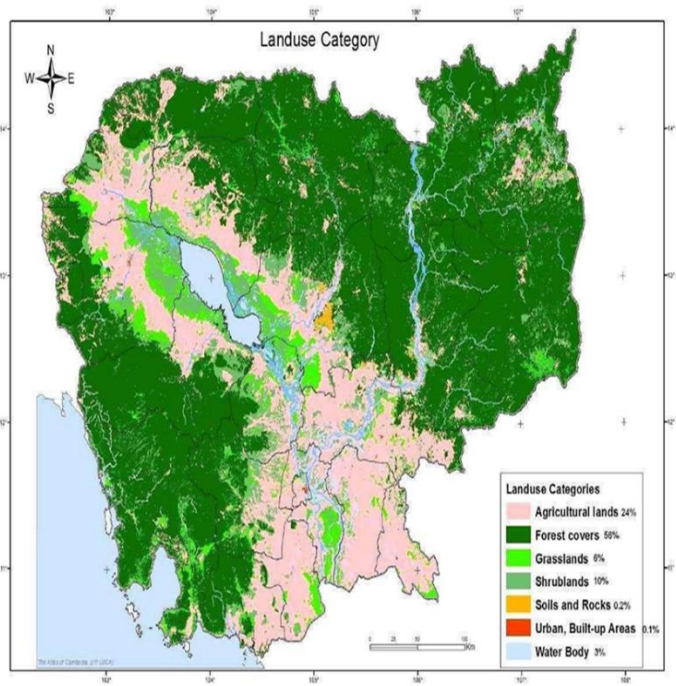
The forest in four Member Countries is not projected to increase, and the development of the surface mining in them is not clear.

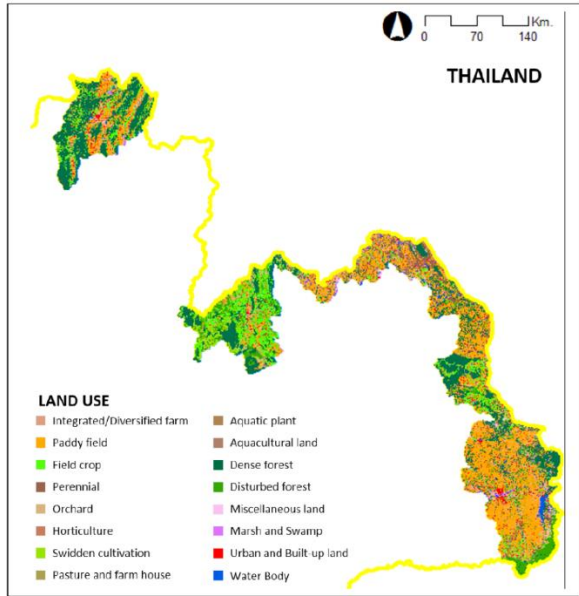
- ***Map planned and existing agriculture and land use change***

In addition to the collection of reports and databases that describe the current and future development of the sector, the national consultants are required to collect and to organize the related geographic datasets.

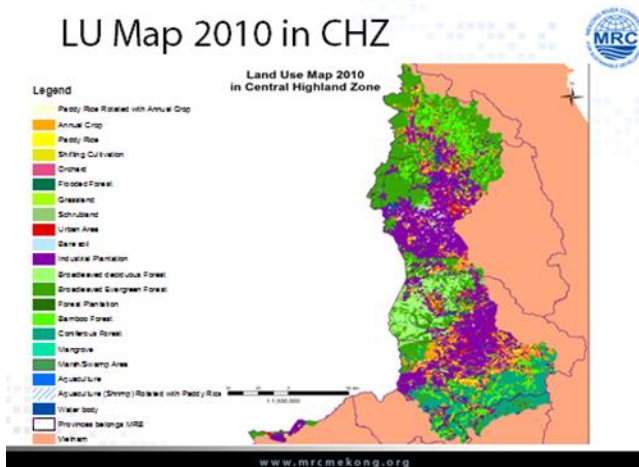
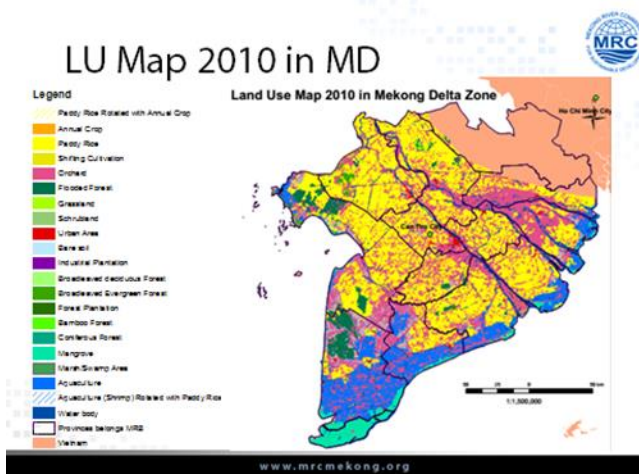
A set of thematic maps have been collected and prepared on purpose to illustrate the current development of the sector within the basin. The set of maps present:

- The overall development at the country level within the LMB,
- The maps for some selected agriculture and land use change schemes.





Land use map of eight provinces



- ***Describe selected agriculture and land use change development projects.***

A specific activity has been assigned to the national consultants. Out of the description of the general national objectives at a country level, it is requested to prepare a report that will describe some selected rain-fed agriculture, forestry, and mining development projects. The description will be compiled in a specific report describing the general parameters of the project. To each project selected will be prepared a specific map and a dataset.

- ***Estimate area change***

The key parameters to be collected to describe the sector development will be mainly focusing on the area change of rain-fed agriculture, forestry, and mining. The parameter is the minimum requested to describe the scenario and the potential impacts. The national consultant is required to describe as precisely as possible in time and space this parameter. The data collection sheets have been developed on purpose.

3.1.3 Preparation of the data collection sheets

The presentation of the methodological approach for the development of the scenario has highlighted the contents to be inquired and the procedure to be followed. To ease the collection process and provide a shared basis to each of the four member countries, some specific data collection sheets have been prepared.

The data collection sheets were organized according to the topics that characterize the agriculture and land use change.

The information collected shall be made available temporally for each of the proposed time frames featured for the Council Study (i.e. 2007 / 2020 / 2040), and spatially allowing the geographic location of the information.

A set of blank spreadsheets has been prepared and was transmitted to each national consultant for compilation. The data collection sheets were further discussed and presented in detail during the meeting and a guideline note was written by the international consultant to describe the process of the sheets compilation.

Scenario element	Data required (different for each scenario)	Current Status (2007, 2020, and 2040 scenarios)	MC Line Agencies to Contact	Known Data Gaps/Assumptions to Make
Current situation	<ul style="list-style-type: none"> - Current land use (map and report) - Demography - Socio-economic condition and 	Land cover/ use map 2010		

	<p>national development policies</p> <ul style="list-style-type: none"> - Data on area, production, technology, water use and land suitability in each sector: <ul style="list-style-type: none"> ✓ Rain-fed agriculture ✓ Surface mining ✓ Aquaculture ✓ Forestry ✓ Livestock grazing 			
Specific plans	<ul style="list-style-type: none"> - Land use plan (map and report): area and spatial distribution of each sector development - Sector development plans on agriculture, forestry, aquaculture, surface mining, and livestock grazing: area, spatial allocation, production, technology, water use, investment, cost benefit analysis... <p><i>Example:</i></p> <ul style="list-style-type: none"> + Land use plan to 2020 in Mekong Delta + Agriculture development plan to 2020 			
Vision/ other plans	<ul style="list-style-type: none"> - Vision/ development directions on land use: changes in land allocation - Vision/ development directions on sector development on agriculture, forestry, aquaculture, surface mining, and livestock grazing: changes in area, production, technology, water use efficiency etc. 			

3.1.4 Collection and Review of the existing data within the MRC (Including GIS)

In parallel with the activities carried out by the national consultants on the agriculture and land use change, a review of the existing data within the MRC database was conducted.

The review concerned the following sources:

- The consolidated GIS dataset
- The datasets and the modelling tools available in the IKMP

This review of dataset will allow the consultants to evaluate the status of the existing data and to develop a strategy for data gap filling.

3.1.5 Coordination with the modelling team for the format of the datasets

Within the framework of the council study, Agriculture and Land Use Change is one of the six thematic areas that are assessed for the potential impacts its development will generate on the lower Mekong basin.

The modelling teams of the MRC will be in charge to assess either the single impact of the specific thematic area development on the LMB but also the cumulated impact of the six thematic areas. Two major modeling teams will be involved:

- The modeling team in charge of the impact assessment on the hydrology of the basin
- The modeling team in charge of the social and economic impact

A strong coordination between the teams is required to ensure a successful understanding of each parties needs and objectives. AIT has conducted several informal meetings with the experts of those discipline teams all along the development of the activities. The major steps are presented below:

- a) Presentation of the agriculture and land use change thematic area needs and objectives and the scenarios to be developed to each one of the discipline team
- b) Discussions on the scenarios /simulations to be developed within the council study
- c) Presentation of the modeling suite that will be used within the council study according to the areas of interest.
- d) Analysis of selected reports on previous modelling activities developed for the BDP2 program describing the procedures for data exchange and model outputs.
- e) Thematic meeting on the data exchange procedures between AIT and IKMP in order to define the data input, the models used, the area of interests and the data in output.

3.1.6 Compilation of draft datasets

The national consultants have started the compilation of the datasets after the technical meeting on the scenario development. Different kinds of difficulties were met by the consultants to compile the datasheets due to several reasons:

- Access to the datasets at the national level describing the current and future development of the sector

- Homogeneity of the information between projects according to their size and their age
- Organization of the datasheet templates not adapted to local particularities
- Absence of planning documents for the time horizons targeted by the council study

Generally, the topics related to the agriculture and land use change were covered but only poor data was made available to describe the social and economic sections and the agronomic parts.

3.1.7 Review and Quality Control

Preliminary versions of the datasets were sent to the AIT that made a first quality control. The datasets were commented and sent back to the national consultants for revision.

3.1.8 Finalization of datasets

At the time of the submission of the draft version of the interim report in December 2016, the datasets for each country had not yet been finalized. Some additional work has been conducted by the national consultants in the first months of 2016 to present a finalized version of their datasets.

These final datasets were reviewed allowing the formulation of the final scenarios.

A strategy was proposed during the 6th RTWG for the finalization of the datasets that will allow the council study to proceed without expecting the national consultants to fill completely the requested datasheets.

In the meanwhile, for the purpose of the interim, a data gap filling strategy was developed to obtain a preliminary homogenous dataset covering each country and time horizon.

3.2 Data gaps

3.2.1 Methodology for the identification of Gaps

- *Discussions with the NC of the data requested*

Discussions started during the working sessions with the national consultants to set up a comprehensive list of the available data within the MCs and the MRC's databases as a result of the past activities. Based on the list of data requested, and the agreed scenarios to be studied, each national consultant will draw up a list of the data available, for each time-frame.

- *Continuous monitoring of the data collection*

The data listing activity was strongly interfaced with the GIS to allow a direct and rapid evaluation of the spatial location of the information.

- *National Consultation meeting*

The national consultation meetings that were held within each country have given the opportunity of a global review of the process of data compilation and report formulation for each thematic area of the council study. These national consultation meetings should have validated the contents of the draft datasets prior to the communication to AIT.

3.2.2 Gaps Identified

This paragraph presents a summary of the gaps that were identified in the datasets. It includes the submissions that were received after the 6th RTWG.

The all necessary data was not submitted by the national consultants, and the submitted data is also inconsistent. Therefore, the available and reliable data is limited for the scenario development.

3.2.3 Need for a Gap Filling Strategy

When the draft interim report was presented in December 2015, the data comparison at the national level had identified some gaps for each country and for each type of data.

Some improvements were made by each team of national consultants in the first months of 2016 to communicate revised datasets.

In the present state, the datasets declared as final by the member countries do not allow to have the necessary information to formulate the scenarios and to further proceed with the impact assessment with the modelling teams.

After the contributions of the national consultants will have been declared completed, a comprehensive dataset that would allow the modelling teams to proceed with the impact assessment will be needed. The final data gap analysis would then be conducted. Considering the completeness of the contributions received, the time and efforts needed to achieve satisfactory results with this option are questionable.

Therefore, to avoid blockage of the council study implementation process, a strategy must be adopted. This strategy will have to work with the following constraints and documents.

- The datasets presented in the national consultants reports and the corresponding data collection sheets with a strong quality control and validation from the national committees;
- Some scientific assumptions based on the best professional judgement and additional scientific sources available in literature
- The guidance of the national consultants

The strategy to be adopted was discussed during the 7th RTWG. Further, a methodological approach will need to be prepared in phase 2.

AIT team provided the collected data from national consultants to the modelling team. The modelling team is checking the collected data and develop the gap filling strategy.

Strategy for the Draft Interim report

For the preparation of the Draft interim report, a first gap filling strategy was proposed to allow the creation of a dataset that would at least illustrate the prospects at a national level and to have at least global figures for discussion. The databases available at the MRC were used to build a homogenous dataset covering at least the primary parameter related to the irrigation area developed. The analysis was only conducted to a national level.

The modelling team is now checking the collected data and reviewing the gap filling strategy.

3.3 Thematic Sub-Scenarios

For 2040 PDS, only one sub-scenario will be assessed based on the discussion of 6th and 7th RTWG meetings. The reasons are as follows:

- Insufficient data on proposed 2040 PDS sub-scenarios (Low, Medium, High) collected
- Sub-scenario for 2040 is required to remain the high priority.

The detail of the sub-scenario for 2040 will be discussed with the modelling team.