Signature Page

PROJECT DOCUMENT

Upon request from the Government of Cambodia, represented by the Ministry of Environment, the Food and Agriculture Organization of the United Nations (FAO) will provide technical assistance for the following Project:

Project Title:	Enhancing sustainability of the Transboundary Cambodia - Mekong River Delta Aquifer
Project Symbol:	GCP /RAS/390/GFF

Upon signature of this project document by duly authorized representatives of both parties, the project will be implemented in accordance with the provisions of the Memorandum of Understanding (Representation Agreement) signed between the Government of Cambodia and FAO on **21 December 1994**, (*and/or, as applicable*: the Legal Annex of the UNDAF 2019-2023 signed between the Government of Cambodia and the United Nations on **06 May 2019**) as well as the project description and management arrangements described herein.

On behalf of: The Government of Cambodia Ministry of Environment	On behalf of: The Food and Agriculture Organization of the United Nations
Name: Sao Sopheap	Name: Rezeki Bell
Title: Secretary of State	Title: FAO Representative Cambodia
Date: 22.09.2022	Date: 12.9.22

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FAO-GEF PROJECT DOCUMENT

Project Title:	Enhancing sustainability of the Transboundary Cambodia - Mekong River Delta Aquifer

GEF ID: 10520	FAO Entity Number: 673261 FAO Project Symbol: GCP /RAS/390/GFF
	Countries: Cambodia; Viet Nam
	EOD (Implementation start): 15 June 2022 NTE (Implementation end): 14 June 2027
Environmental and Social Risk Classification:	low risk √ moderate risk □ high risk □
Gender Marker:	G0 □ G1 √ G2a □ G2b □

Contribution to FAO's Strategic Framework: (Indicate as appropriate)	**Strategic Objective/Organizational Outcome:**
	• ***Strategic Objective 2*:** Increase and improve provision of goods and services from agriculture, forestry, and fisheries in a sustainable manner
	  • *Output 2.1.1:* Practices piloted, tested or scaled up by producers, to sustainably increase productivity, address climate change and environmental degradation
	  • *Output 2.1.2:* Capacities of institutions are strengthened to promote the adoption of more integrated and cross-sectoral practices that sustainably increase production, address climate change and environmental degradation, and;
	• ***Strategic Objective 5:*** Increase the resilience of livelihoods to threats and crises
	• *Output 5*.3.2 Communities equipped with vulnerability reduction practices and measures
	
	Country Programming Outcomes:
	
	<u>*Viet Nam*</u>
	• *Outcome 1:* Increased food security with focus on alleviation of hunger, malnutrition and food safety concerns
	• *Outcome 2*: Sustainable development of the agriculture sectors (including crop production, livestock, fisheries and forestry), contributing to the national Green Growth and other strategies on improved natural resources management and environment protection
	• *Outcome 3:* New Rural Development and Sustainable Poverty Reduction
	• *Outcome 4:* Enhancing resilience of communities to disasters and threats.
	
	<u>*Cambodia*</u>

	• *Outcome 1:* Enhanced agricultural productivity, diversification and commercialization, and safe and nutrition-sensitive food systems for poverty reduction and food and nutrition security, • *Outcome 2:* Equitable and sustainable management of natural resources, and increased capacity to monitor and report climate action **Country Programme Framework Outcomes.** <u>*Viet Nam*</u> • *Output 2.2:* Strengthened institutional and technical capacities for implementation of the Nationally Determined Contribution (NDC) through evidence-based decision-making process and fulfilling international commitments in agriculture sector to mitigate climate change impacts. • *Output 4.4:* Support to better preparedness and coordination and response at community and policy levels to emergencies and crises that affect the natural resources/agricultural livelihood/nature. <u>*Cambodia*</u> • *Outcome 2:* Equitable and sustainable management of natural resources, and increased capacity to monitor and report climate action **Regional Initiative/Priority Area:** Regional initiatives in International Waters, Restoration, Climate Change and Zero Hunger.
	Project Budget (GEF/SCCF/LDCF): USD 15 000 000 Co-financing: USD 114 586 875 Total Project Budget: USD 129 586 875

Executive Summary

This is a bilateral GEF IW project between Cambodia and Viet Nam focused on the improved transboundary management of the shared Cambodia-Mekong Delta Aquifer (CMDA). Key challenges include (i) rapid groundwater decline, (ii) land surface subsidence, (iii) increasing levels of arsenic and other contaminants, (iv) salinity intrusion, and (v) degrading groundwater dependent ecosystems. Climate change and upstream development are expected to deepen the vulnerability of the aquifer and dependent livelihoods and ecosystems, as future scenarios highlight accelerating threats for large parts of the population living in Cambodia and Viet Nam's Mekong Delta.
The project objective is "to strengthen environmental sustainability and water security in the Lower Mekong Basin by investing, for the first time, on improved governance and sustainable utilization of the Cambodia-Mekong River Delta Transboundary Aquifer". Specific Outcomes include:

- Outcome 1: Consensus among countries on key transboundary and national concerns affecting the aquifer, reached through joint fact finding, opening pathways to concerted remedial actions

- Outcome 2: Tested strategies for improved groundwater recharge, reduced extraction and mitigated ecosystem/ livelihoods trade-offs
- Outcome 3: Agreed improvements of transboundary cooperation improve aquifer transboundary governance
- Outcome 4: Commitment reached among countries on implementing priority legal, institutional and policy reforms and investments for the protection and equitable utilization of the shared aquifer and its' dependent ecosystems
- Outcome 5: Implementation of project mechanisms for monitoring, improved stakeholder consultation, gender mainstreaming, dissemination, coordination and monitoring progress enhance long-term sustainability of achievements.

Establishing transboundary groundwater management mechanisms for CMDA is paramount for sustainable development, mainly involving the conjunctive management of surface and groundwater resources enhancing synergies with biodiversity conservation (e.g. wetland management), forests and inland fisheries management, and resolving conflicts at the food, energy and environment nexus.

FAO will be the Implementing Agency and International Union for Conservation of Nature (IUCN) has been selected as the Lead Executing Agency (Lead Operational Partner). The TDA process will be largely executed by UNESCO and the Mekong Region Futures Institute (MERFI) while IUCN will lead all SAP related steps, supported by other executing agencies and the Cambodia and Viet Nam National Mekong Committee (CNMC & VNMC). UNESCO WWAP will coordinate gender focused activities. The countries will execute pilot projects, which will be based on TDA results and inform the SAP formulation process.

Contents

Acronyms

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
AF	Administration of Forestry (MARD, Viet Nam)
ASR	Aquifer Storage Recovery and Reuse
AWD	Alternate wetting and drying
BAU	Business as usual
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)
BMBF	Bundesministerium für Bildung und Forschung
CA	Cambodia
CAVAC	Cambodia Agricultural Value Chain Program
CMDA	Cambodia-Mekong Delta Aquifer
CNMC	Cambodia National Mekong Committee
CP	Causal Pathway
CWP	Cambodia Water Partnership
DARD	Department of Agriculture and Rural Development (Viet Nam)
DCC	Department of Climate Change
DEM	Digital Elevation Model
DF	Directorate of Fisheries (MARD, Viet Nam)
DFWC	Department of Freshwater Wetlands Conservation (MoE Cambodia)
DIT	Department of Industry and Trade (Viet Nam)
DOI	Department of Irrigation (MoWRAM, Cambodia)
DOL	Department of Legislation (MoNRE, Viet Nam)
DOLISA	Department of Labors, Invalids and Social Affairs (Viet Nam)
DoNRE	Department of Natural Resources and Environment (Viet Nam)
DPI	Department of Planning and Investment
DPS	Department of Planning and Statistics (MAFF, Cambodia)
DRWH	Department of River work and hydrology (MoWRAM, Cambodia)
DWR	Directorate of Water Resources (MARD, Viet Nam)
DWRM	Department of Water Resources Management (MoNRE, Viet Nam)
DWRPIS	Division for Water Resources Planning and investigation for the South of Viet Nam
EA	Environment Administration (MoNRE, Viet Nam)
ESM	Environmental and Social Risk Management
ESI	Environmental Status Indicators
EQ	Environmental Quality
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FHF	Female-headed families
FiA	Fisheries Administration (MAFF, Cambodia)
FOLUR	Food systems, land use and resoration
FPMIS	(FAO)
GAP	Gender Action Plan
GDA	General Directorate of Agriculture (MAFF, Cambodia)
GDDPC	General Department of Disaster Prevention and Control (MARD, Viet Nam)
GDE	Groundwater Dependent Ecosystems
GDEKM	General Department of Education and Knowledge Management (MoE Cambodia)
GEB	Global Environmental Benefits
GEFTF	Global Environment Facility Trust Fund
GHG	Greenhouse Gas
GMS	Greater Mekong Subregion
GW	Groundwater
HCMC	Ho Chi Minh City
HA	Hectares
ICD	Department of International Cooperation (MoNRE, Viet Nam)
ICRSL	Integrated Climate Resilience and Sustainable Livelihoods (World Bank)
IDA	International Development Association (World Bank)

IFAD	International Fund for Agricultural Development
IHP	International Hydrological Programme (UNESCO)
IMC	Inter-ministerial Committee
IMHEN	Institute of Meteorology, Hydrology, and Climate Change (MoNRE, Viet Nam)
IoT	Internet of Things
IP	Indigenous People
IRRI	International Rice Research Institute
IUCN	International Union for Conservation of Nature
IW	International Waters
IWRM	Integrated Water Resource Management
IWRP	Institute of Water Resources Planning (MARD, Viet Nam)
JICA	Japan International Cooperaton Agency
JTC	Joint Technical Committee
LDCF	Least Developed Countries Fund
KfW	Kreditanstalt für Wiederaufbau
KIGAM	Korea Institute of Geoscience and Mineral Resources
LMC	Lancang-Mekong Cooperation
LOP	Lead Operational Partner
LTO	Lead Technical Officer
MAFF	Ministry of Agriculture, Fisheries and Forestry (Cambodia)
MAR	Managed Aquifer Recharge
MARD	Ministry of Agriculture and Rural Development (Viet Nam)
MERFI	Mekong Region Futures Institute
MoE	Ministry of Environment (Cambodia)
MOF	Ministry of Finance (Viet Nam)
MOFA	Ministry of Foreign Affairs (Viet Nam)
MOFAIC	Ministry of Foreign Affairs and International Cooperation (Cambodia)
MOIT	Ministry of Industry and Trade (Viet Nam)
MoNRE	Ministry of Natural Resources and Environment (Viet Nam)
MoP	Ministry of Planning (Cambodia)
MoU	Memorandum of Understanding
MoWRAM	Ministry of Water Resources and Meteorology
MPI	Ministry of Planning and Investment (Viet Nam)
MRC	Mekong River Commission
MRD	Ministry of Rural Development (Cambodia)
MWA	Ministry of Women's Affair (Cambodia)
NbS	Nature-based Solutions
NCSD	National Council for Sustainable Development (Cambodia)
NDC	Nationally Determined Contribution
NGO	Non-Government Organisation
NMCs	National Mekong Committees
NPMU	National Project Management Unit
NWO	Nederlandse Organisatie voor Wetenschappelijk Onderzoek (Dutch Research Council)
OED	Office of Evaluation
OI	Outcome Indicator
OP	Operational Partner
PCONRD	Program Coordination Office of the National Target Program on New Rural Development
PIF	Project Identification Form
PIR	Project Implementation Report
PMC	Project Management Cost
PMU	Project Management Unit
PPG	Project Preparation Grant
PTF	(FAO)
RDI	Rural Development Institute
RGC	Royal Government of Cambodia
RPMU	Regional Project Management Unit
RPSC	Regional Project Steering Committees

SAP	Strategic Action Programme
SCCF	Special Climate Change Fund (GEF)
SDG	Sustainable Development Goals
SM	Stocktaking meeting
SRTM	Shuttle Radar Topography Mission
TA	Technical Assistance
TBA	Transboundary aquifer
TBC	To be confirmed
TCCB	Transboundary Consultation and Coordination Body
TDA	Transboundary Diagnostic Analysis
TE	Terminal Evaluation
ToC	Theory of Change
TSA	Tonle Sap Authority (Cambodia)
TWAP	Transboundary Water Assessment Programme (GEF)
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Emergency Fund
VMHA	Viet Nam Meteorological and Hydrological Administration
VN	Viet Nam
VNFU	Vietnamese Farmer's Union
VNMC	Viet Nam National Mekong Committee
VNWRA	Viet Nam Academy for Water Resources (MARD, Viet Nam)
VNWU	Vietnamese Women's Union
VRN	Viet Nam River Network
VUSTA	Viet Nam Union of Science and Technology Associations
WB	World Bank
WHO	World Health Organisation
WWAP	World Water Assessment Programme
WWDR	World Water Development Report

PART I: PROJECT INFORMATION

Project Title: Enhancing sustainability of the Transboundary Cambodia - Mekong River Delta Aquifer			
Country(ies):	Cambodia, Viet Nam	GEF Project ID:	10520
GEF Agency(ies):	FAO (select) (select)	GEF Agency Project ID (FAO entity number):	FPMIS 673261
Project Executing Entity(s):	IUCN, UNESCO, Cambodia Ministry of Environment (MOE), Viet Nam Ministry of Natural Resources and Environment (MONRE)	Submission Date	2 December 2021
GEF Focal Area (s):	International Waters	Expected Implementation Start	15 June 2022
		Expected Completion Date	14 June 2027
Name of Parent Program		Parent Program ID:	

A. FOCAL/NON-FOCAL AREA ELEMENTS

Programming Directions	Focal Area Outcomes	Trust Fund	(in USD)	
			GEF Project Financing	Co-financing
(select) IW-3-5	Enhance water security in freshwater ecosystems through advance information exchange and early warning	GEFTF	4 500 000	43 371 668
(select) IW-3-6	Enhance water security in freshwater ecosystems through enhanced regional and national cooperation on shared freshwater surface and groundwater basins	GEFTF	5 950 000	15 635 218
(select) IW-3-7	Enhance water security in freshwater ecosystems through investments in water,	GEFTF	4 550 000	55 579 989

	food, energy and environment security			
Total project costs			15 000 000	114 586 875

B. PROJECT DESCRIPTION SUMMARY

Project Objective: To strengthen environmental sustainability and water security in the Lower Mekong Basin by investing, for the first time, in improved governance and sustainable utilization of the Cambodia-Mekong River Delta Transboundary Aquifer.

Project Components	Component Type	Project Outcomes	Project Outputs	Trust Fund	(in USD) GEF Project Financing	(in USD) Co-financing
Component 1 Joint science-based diagnostic for groundwater dynamics (recharge and extraction) and effects on ecosystems (e.g. fish, wetlands) and livelihoods	TA	Outcome 1 Consensus among countries on key transboundary and national concerns affecting the aquifer, reached through joint fact finding, opening pathways to concerted remedial actions. Outcome Indicator (OI): TDA and the Environmental Status Indicators (ESI) endorsed by the country representatives in the Steering Committee.	Output 1.1 Assessment of current state of groundwater resources, recharge and extraction dynamics Output 1.2 Analysis of groundwater related dependencies of related ecosystems Output 1.3 Agreed upon Transboundary Diagnostic Analysis (TDA), including assessment of related governance, socio-economic, legal and gender aspects. Output 1.4 Agreement reached on Environmental Status Indicators.	GEFTF	4 388 523	26 000 000
Component 2 Piloting solutions for improved transboundary groundwater management.	Investment	Outcome 2 Tested strategies for improved groundwater recharge, reduced extraction and mitigated	Output 2.1 Pilot demonstrations of innovative groundwater management and utilization	GEFTF	4 550 000	76 000 000

		ecosystem/ livelihoods trade-offs OI: Demonstration project designs, implementation reports, and upscaling-focused assessments for three demonstration projects for improved groundwater management (extraction and recharge) in each country	after adequate feasibility studies			
Component 3 Transboundary cooperation mechanisms	Technical A	Outcome 3. Agreed improvements of transboundary cooperation improve aquifer transboundary governance OI: Agreement on the creation of a Bilateral coordination and consultation body (TCCB) signed by two countries.	Output 3.1 Harmonized design of groundwater monitoring networks and protocols Output 3.2 Agreement on groundwater data exchange mechanisms and procedures. Output 3.3 Design of permanent transboundary consultation and coordination body (TCCB).	GEFTF	2 192 709	5 000 000
Component 4 Joint strategies and action programs	Technical A	Outcome 4 Commitment reached among countries on implementing priority legal, institutional and policy reforms and investments for the protection and equitable utilization of the shared aquifer	Output 4.1 Countries establish Joint Technical Committees (JTCs) and ad hoc inter-ministerial committees. Output 4.2	GEFTF	980 960	1 056 500

		and its dependent ecosystems OI: SAP approved/signed by the relevant Minister(s) in each country.	A shared long-term Vision (horizon 20 years) including the agreement on environmental quality targets. Output 4.3 Strategic Action Program (SAP) with horizon of 5 years, consistent with the Shared Vision.			
Component 5 Reinforced institutional capacity, improved participation, gender mainstreaming, monitoring and coordination.	Technical A	Outcome 5. Implementation of project mechanisms for monitoring, improved stakeholder consultation, gender mainstreaming, dissemination, coordination and monitoring progress enhance long-term sustainability of achievements. OI: Skills and knowledge on transboundary issues of 100 gender-balanced national staff increased by 50 percent over baseline levels.	Output 5.1 Structured capacity building in groundwater governance for decision makers and other stakeholders. Output 5.2 Annual stocktaking and awareness raising meetings with relevant stakeholders (e.g. local, national and regional meetings) Output 5.3 Water and Gender Action Plans and indicators, based on results of Component 1, adopted by relevant authorities in both countries Output 5.4	GEFTF	2 173 522	801 031

			Periodic events for the coordination with other ongoing initiatives organized by the PMU/TCCB Output 5.5 Full participation to GEF IW LEARN activities, creation of a project website, and preparation of experience notes.			
				Subtotal	GEFTF	14 285 714	108 857 531
				Project Management Cost (PMC)	GEFTF	714 286	5 729 344
				Total Project Cost		15 000 000	114 586 875

For multi-trust fund projects, provide the total amount of PMC in Table B, and indicate the split of PMC among the different trust funds here: ( )

C. CONFIRMED SOURCES OF CO-FINANCING FOR THE PROJECT BY NAME AND BY TYPE

Sources of Co-financing	Name of Co-financier	Type of Co-financing	Investment Mobilized	Amount (USD)
Recipient Country	Cambodia Ministry of Agriculture, Forestry and Fisheries	Public Investment	Investment mobilised	32 000 000
Recipient Country	Cambodia Ministry of Evironment	Public Investment	Investment mobilised	2 000 000
Recipient Country	Cambodia Ministry of Rural Development	Public Investment	Investment mobilised	11 000 000
Recipient Country	Cambodia Ministry of Water Resources and Meteorology	Public Investment	Investment mobilised	20 500 000
Recipient Country	Viet Nam	Public Investment	Investment mobilised	43 500 000
GEF Agency	Food and Agriculture Organisation (FAO)	In-kind	Recurrent expenditures	1 020 875
Donor Agency	International Union for Conservation of Nature (IUCN)	In-kind	Recurrent expenditures	2 000 000

Donor Agency	United Nations Educational, Scientific and Cultural Organization (UNESCO)	In-kind	Recurrent expenditures	1 200 000
Donor Agency	United Nations Educational, Scientific and Cultural Organization World Water Assessment Programme (UNESCO WWAP)	In-kind	Recurrent expenditures	896 000
Foundation and Trusts	Mekong Region Futures Institute (MERFI)	In-kind	Recurrent expenditures	470 000
Total Co-financing				114 586 875

Describe how any "Investment Mobilized" was identified.

The public investments reported as Co-Financing from Cambodia and Viet Nam were identified in a series of discussions with four central Government Ministries, namely:

Cambodia: Ministry of Agriculture, Forestry and Fisheries (MAFF), Ministry of Environment (MoE), Ministry of Rural Development (MRD), and Ministry of Water Resources and Meteorology (MoWRAM);

Viet Nam: Ministry of Natural Resources and Environment (MoNRE).

The related letters of co-financing (attached to the submission), were all agreed upon by the respective manager of the initiatives/projects listed here under.

All the Co-Financing from the two recipient countries was reported as "Investment Mobilized" because it excludes recurrent expenditures. All the investments contribute directly or indirectly to the achievement of the objectives of the project. However, strictly speaking, none of these public investments are directly mobilized by the GEF grants allocated to the project.

Without the GEF Project Enhancing sustainability of the Transboundary Cambodia - Mekong River Delta Aquifer though, these public investments in Cambodia and Viet Nam will happen in isolation without any coordination and synergies within and between the countries.

The GEF investment in this region, allows for the full coordination and for the financing of the additional costs associated with transforming the public investments listed in Table C, from national benefits into global environmental benefits impacting positively the Mekong River Delta Aquifer and its related ecosystems.

The "Public investments" - "Investments mobilized" in the two countries consist of:

Cambodia*:
- USD 18 m Climate-friendly agri-business value chains Sector Project (part of USD 130m, ADB)
- USD 8 m Agricultural Diversification (part of a USD 101.67m, World Bank)
- USD 6 m Agricultural Services Programme Innovation, Resilience, and Extension (ASPIRE) (part of USD 52.5m, IFAD)
- USD 2 m Sustainable Landscape and Ecotourism Project (CSLEP) (part of USD 54m, World Bank)
- USD 9 m Rural water supply and sanitation project (ADB)
- USD 1 m Installation of hand pumps for rural water supply (Gov of India)
- USD 1 m Improving Rural water supply (China Aid)

• USD 9 m Irrigated Agriculture Improvement Project (collaboration with ADB) funding the National Water Resource Data Centre
• USD 8 m Uplands irrigation and water resource management sector project (ADB)
• USD 0.5 m Integrated Water Resource Management project (World Bank)
• USD 3 m Water resource management and agro-ecological transition (WAT4CAM) (AFD)

*: The dollar amount shown represents the approximate value of the components relevant for this GEF project of the investments listed above. For this reason, only a fraction of these investments listed in the ministerial Co-Financing letters have been listed according to how much falls within the project's target area and into the relevant time frame.

Viet Nam*:
• The project "Enhancing the resilience inclusive and sustainable eco-human settlement development through small scale infrastructure interventions in the coastal regions of the Mekong Delta in Viet Nam" (2020-2023);
• The project "Identification of scientific solutions, technologies and policies to manage and protect groundwater and to treat and supply clean water to high mountainous and water scarcity areas" (2015-2023);
• The project "Carrying out investigation and preliminary assessment of groundwater resources at scale of 1:50 0000 in the North of Tien River" (2021-2025);
• The project "Protection of groundwater in urban - Phase II, including Ca Mau, Bac Lieu, Rach Gia and Long Xuyen cities" (2020-2022);
• The project "Investigation and detection of groundwater in high mountainous and water scarcity areas" (2015-2023);
• The project "Improvement of Groundwater Protection in Vietnam (IGPVN)" (IGPVN) (2022-2025).
* The dollar amount shown represents the approximate value of the components relevant for this GEF project of the investments listed above. For this reason, only a fraction of these investments listed in the ministerial Co-Financing letters have been listed according to how much falls within the project's target area and into the relevant time frame.

D. TRUST FUND RESOURCES REQUESTED BY AGENCY(IES), COUNTRY(IES), FOCAL AREA AND THE PROGRAMMING OF FUNDS

GEF Agency	Trust Fund	Country Name/ Global	Focal Area	Programming of Funds	(in USD)		
					GEF Project Financing (a)	Agency Fee (b)	Total (c)=a+b
FAO	GEF TF	Regional	International Waters		15 000 000	1 350 000	16 350 000
Total GEF Resources					15 000 000	1 350 000	16 350 000

E. DOES THE PROJECT INCLUDE A "NON-GRANT" INSTRUMENT? *No*

F. PROJECT'S TARGET CONTRIBUTIONS TO GEF 7 CORE INDICATORS

Project Core Indicators		Expected at CEO Endorsement
1	**Terrestrial protected areas** created or under improved management for conservation and sustainable use (Hectares)	NA
2	**Marine protected areas** created or under improved management for conservation and sustainable use (Hectares)	NA
3	Area of **land restored (**Hectares)	NA
4	Area of **landscapes under improved practices** (excluding protected areas) (Hectares)	NA
5	Area of **marine habitat under improved practices** (excluding protected areas) (Hectares)	NA
6	**Greenhouse Gas Emissions Mitigated** (metric tons of CO2e)	NA
7	**Number of shared water ecosystems** (fresh or marine) under new or improved cooperative management	1
8	Globally over-exploited **marine fisheries** moved to more sustainable levels (metric tons)	NA
9	**Reduction**, disposal/destruction, phase out, **elimination** and avoidance of **chemicals of global concern** and their waste in the environment and in processes, materials and products (metric tons of toxic chemicals reduced)	NA
10	Reduction, avoidance of emissions of **POPs to air** from point and non-point sources (grams of toxic equivalent gTEQ)	NA
11	Number of **direct beneficiaries disaggregated by gender** as co-benefit of GEF investment	Ca. 120 000 *(50 percent men;* *50 percent women)*

PART II: PROJECT JUSTIFICATION

1.a Project Description

1) The global environmental and/or adaptation problems, root causes and barriers that need to be addressed (systems description).

The lower section of the Mekong River Basin is underlain by a major transboundary aquifer system shared by Cambodia and Viet Nam: *The Cambodia – Mekong River Delta Aquifer (CMDA) [AS89 of the Transboundary Waters Assessment Program Inventory, 2016 (GEF/UNEP)]*. This transboundary aquifer (TBA) system (Figure 1) connects two ecosystems of global environmental significance and socio-economic importance, namely: the (i) Tonle Sap area and the (ii) Mekong Delta, and includes some major urban areas, including Phnom Penh and Ho Chi Minh. The lower part of the area is dominated by the largely flat lands of the Mekong river delta, which lies mostly within Viet Nam. The whole CMDA area is approximately 200 000 km^2 with about 63 percent lying within Cambodian territory. Around 35 million people live in the CMDA recharge zone and the vast majority of households depend on groundwater for drinking or for irrigation. However, groundwater management faces severe challenges, including over-extraction, loss of recharge zones, climate change, arsenic pollution, salinity intrusion, and land subsidence. Transboundary solutions are paramount to address the mounting challenges.

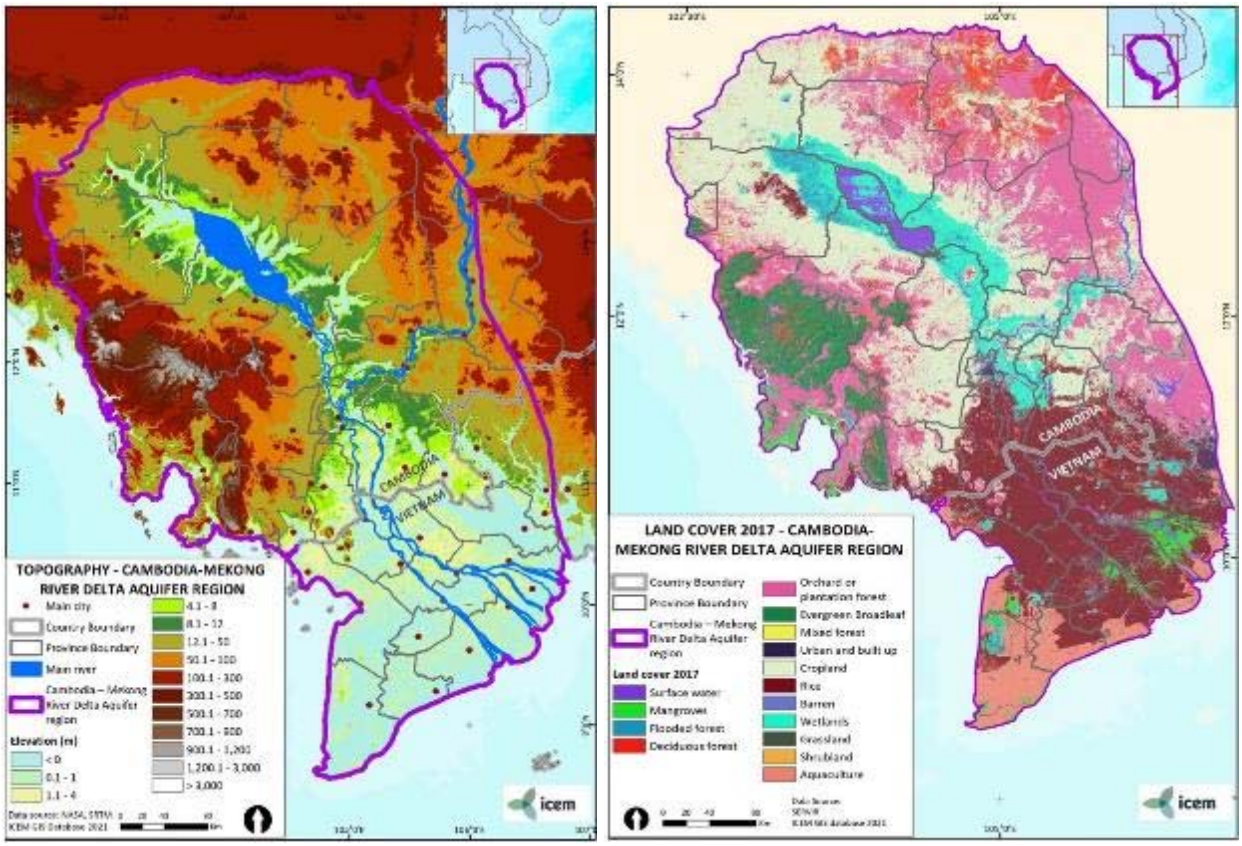


FIGURE 1: TOPOGRAPHY (LEFT) AND LAND COVER (RIGHT) OF THE CMDA AREA

Annex M1 provides data and research details on the various aquifer segments, the underlying geology, climate conditions, and the relevant aspects of surface water hydrology (ICEM. 2021. Deploying nature-based solutions (NBS) as specific measures to address agroecosystem degradation and associated drivers and generate environmental benefits at multiple scales *Final NBS Report*. Prepared for FAO).

Land cover in the CMDA area has been substantially modified by human activity (see Figure 1). The most significant blocks of remaining forest are located on the Cardamom mountain range in Cambodia. Most of the middle and lower lying area is dominated by crop land and plantations: the Mekong Delta portion is dominated by intensive rice cropping featuring seasonal flooding, and closer to the coast, shrimp aquaculture.

The CMDA area contains large areas of wetlands (Figure 2), many of which are of major importance for biodiversity and/or for livelihoods, especially for rice-farming and fisheries; conditions in these wetlands are in most cases strongly related to those of the CMDA, especially groundwater levels. Vice versa, wetlands sustain roundwater levels, emphasising the symbiotic relationships between wetlands and groundwater aquifers. Major wetland types include the Tonle Sap lake; the marshes and seasonally-flooded forest surrounding it (which also occur in other parts of the region); the seasonally flooded rice landscapes of the Mekong Delta; and the coastal mangroves of the lower Mekong Delta.

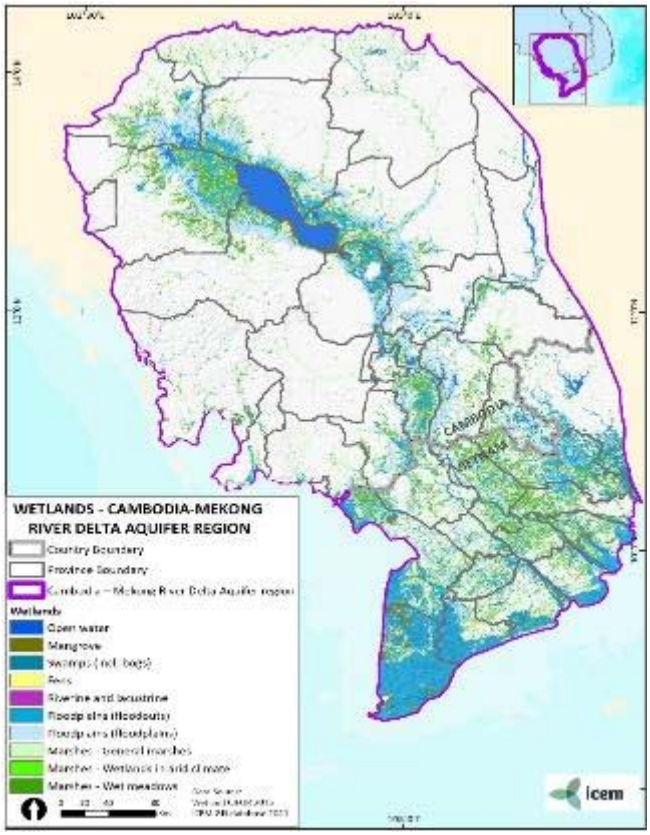


FIGURE 2: WETLANDS OF THE CMDA AREA (ICEM 2021)

On the Cambodian side of the TBA three main zones can be distinguished, (i) the Cambodian Mekong Delta Zone, (ii) Tonle Sap Lake Zone, and (iii) Coastal Plain Zone of Southwestern Cambodia. Tonle Sap, the largest lake in the Indochina Peninsular, is hydraulically connected to the Mekong River and serves as a natural regulating reservoir.

On the Viet Nam side, the CMDA connects the Mekong Delta and Ho Chi Minh City. Viet Nam's Mekong Delta covers 39 734 km² and locates at the southern part of Viet Nam, limited by the Gulf of Thailand to the southwest, East Sea to the south and southeast, Ho Chi Minh City to the east, Cambodia boundary to the north. The Mekong Delta includes the whole areas of Long An, Dong Thap, An Giang,

Tien Giang, Ben Tre, Vinh Long, Tra Vinh, Hau Giang, Soc Trang, Bac Lieu, Kien Giang, Ca Mau provinces and Can Tho city.

Current uses of groundwater resources

Cambodia is considered one of the most water-abundant countries in the region. Rivers, streams, lakes, aquifers and marine water are important sources for national economic development in many sectors, such as agriculture, manufacturing and small-scale industries, hydropower, navigation, tourism, and key for environmental protection and daily life of the population. The maximum quantity of annual water consumption is estimated to be 750 million m^3 (10 percent of the country's total available water), of which 95 percent (710 million m^3) is used for irrigated agriculture. Groundwater is mostly used for **agricultural activities**, which **account for more than 80 percent of the total groundwater usage in Cambodia**. Groundwater is available almost everywhere in the plains area, except for the dry zone in the central and north-western regions.

The exploitation and utilization of deep/shallow confined groundwater from the Cambodia Mekong Delta aquifer can be approximated based on the water balance method considering irrigation water requirements and evapotranspiration. Table 1 summarizes the irrigation requirements for the Cambodian side of the CMDA and estimate the total groundwater use for irrigation purposes at 614.9 Million m^3/year. The estimated groundwater use for domestic purposes in the Cambodian side of the CMDA (Table 1) is approximately 201.7 Million m^3/year. Unfortunately, no data is available for industrial use of groundwater despite the fact that the industrial sector has become a major user and is mainly located on the outskirts of the capital and provinces.

TABLE 1: ESTIMATED GROUNDWATER EXPLOITATION IN CAMBODIA MEKONG DELTA

Zone	Estimated groundwater use for irrigation (Million m^3/year)	Total Domestic water use (Million m^3/year)	Total abstraction (Million m^3/year)
Tonle Sap Lake zone	390.0	77.4	467.3
Delta zone in Cambodia	225.0	124.3	349.3
Cambodia Mekong Delta Aquifer	614.9	201.7	816.6

Groundwater recharge rate and rainfall data have been estimated in a recent study (including ADB, 2014) to range from 14.9 percent to 22.1 percent of total annual rainfall. These estimates are rather high if compared to FAO's estimate that in average only 5 percent of the country's annual rainfall recharge aquifers.

On Viet Nam's side, a study by the Division for Water Resources Planning and Investigation for the South of Viet Nam in 2014 shows that there are 553 135 abstraction wells and the amount of groundwater abstraction is 1 798 256 m^3/day. Annex M1 explains how seven layered aquifer segments can be distinguished and Table 2 provides extraction data for each of these segments. Annex M2 provides the provincial breakdown.

TABLE 2: LAYERED AQUIFERS IN VIET NAM'S MEKONG DELTA

Data for 2010	Holocone aquifer qh	*Upper Pleistocene aquifer, qp3*	*Upper-Middle Pleistocene aquifer, qp2-3*	*Lower Pleistocene aquifer, qp1*	*Middle Pliocene aquifer, n22*	*Lower Pliocene aquifer, n21*	*Upper Miocene aquifer, n13*
Abstraction m^3/day	17 851	114 945	997 514	130 077	477 395	87 652	87 652

Vuong B.T and et al (2014) assessed groundwater recharge for the whole delta, see Figure 3. The quantity of groundwater recharge in the rainy season is 2 to 7 times greater than that in the dry season. The quantity of annual groundwater recharge varies from about 2.5 to 4.6 Mm^3/day (Figure 3) during the wet season and seems not to follow any trend but is highly variable. Cao Xuan Viet et al. (2019) estimated groundwater recharge in the Ho Chi Minh City area to be 1 552 043 m^3/day.

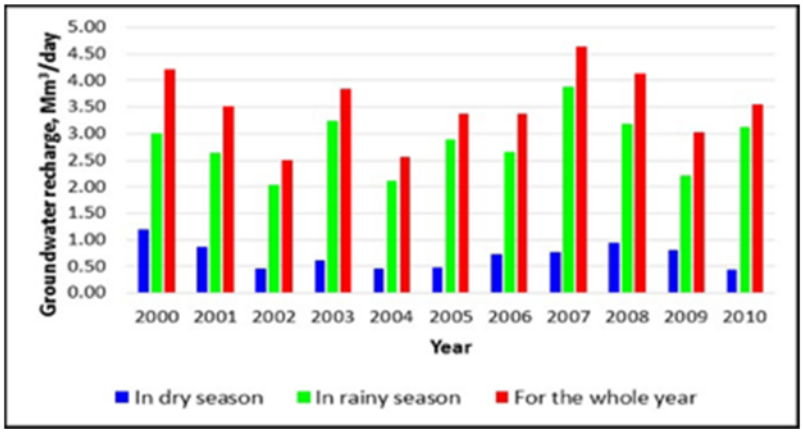


FIGURE 3. ANNUAL GROUNDWATER RECHARGE IN PERIOD 2000 TO 2010 (VUONG B.T. AND ET AL., 2014(1). BÁO CÁO ĐÁNH GIÁ CHẤT LƯỢNG TÀI NGUYÊN NƯỚC DƯỚI ĐẤT (THE REPORT ON ASSESSMENT OF GROUNDWATER QUALITY). ARCHIVED AT THE DIVISION FOR WATER RESOURCE PLANNING AND INVESTIGATION, HOCHIMINH CITY)

Annex M2 provides an overview for exploitable groundwater reserves.

Land cover related recharge reductions

The major drivers for aquifer recharge are land cover change and change in surface water flows. While the latter is driven by climate change and surface water management – including hydropower and flow diversion – land development is driven by a complex array of socio-economic factors (e.g. urbanization, timber demand, mining). The evaluation of groundwater resources in inundated areas of the Mekong River basin in Cambodia by Kazama et al. (2007) showed that land use change leading to a reduction of inundation areas, which leads to a severe reduction of groundwater recharge. In 1993, a 19 percent reduction in inundation areas resulted in a 31 percent reduction in groundwater storage and in 1998, a 44 percent reduction in inundation areas led to a 42 percent reduction in groundwater storage (Kazama et al., 2007). It concludes that even though flood control activities are important to reduce negative flood impacts in the Mekong River basin, they also negatively impact groundwater resources in the area (Kazama et al.,2007).

Viet Nam experienced in recent decades substantial land use and land cover (LULC) change in the Mekong Delta. Residential land surged and reached 3 251 348 ha in 2015. Aquaculture had the largest growth rate and covered in 2015 approximately 720 913 ha (Figure 4), accounting for 19 percent of the study area. The area of mangrove forest gradually decreased from 1979 to 1995, and then stabilized.

Compared to 1979, the area of mangrove forests decreased by 27 899 ha in 2015. Forests experienced a similar trend (Figure 4).

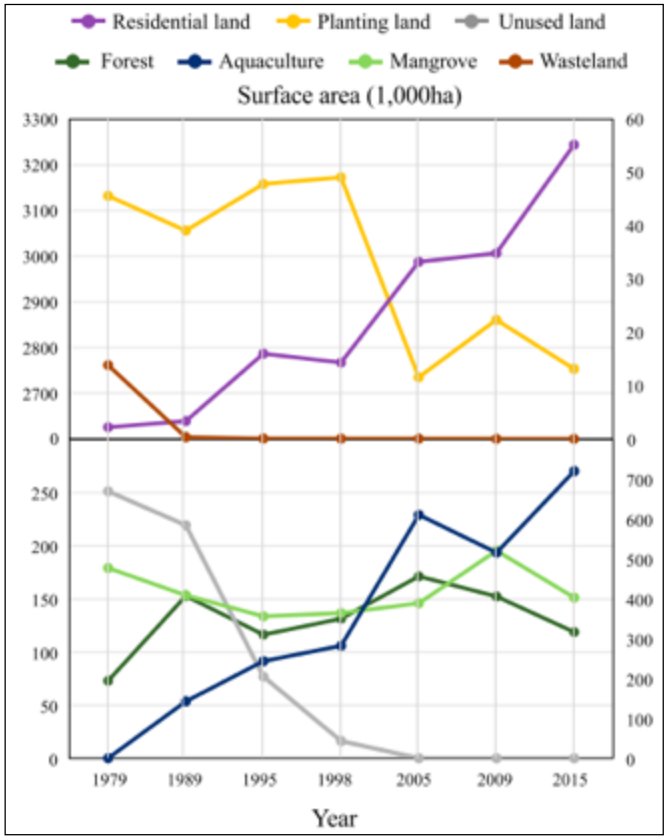


FIGURE 4. THE SURFACE AREA OF LULC TYPES IN THE MEKONG DELTA FROM 1979 TO 2015 (CREATED BY AUTHORS)

Ho Chi Minh City area experienced an increase of *non-agricultural area* from 251km^2 in 2002 to 285 km^2 in 2010 and an increase of *urban area* from 371km^2 to 424km^2 (Nguyen Thanh Son et al., 2012). These data indicate recharge areas could have decreased adversely affecting groundwater recharge. In addition, conversion of rural into urban land has led to increased pumping in many areas, and more importantly, extensive pollution of both surface streams and shallow aquifer due to direct disposal of municipal solid waste and wastewater in rivers and their flood plains.

Land use change affects groundwater recharge rates drastically. This is particularly relevant for delta area as slopes are small: land use changes reduce the rainfall partitioning to groundwater recharge more than in mountainous areas. Forest and grass generate the most groundwater recharge. Paddy field has a small groundwater recharge rate. Recharge in residential and urban areas is even lower. ***These trends highlight that integrated land use planning is needed*** across the CMDA so groundwater recharge is considered in land use change decisions.

Challenges affecting the CMDA

Rapid groundwater level decline due to over-extraction and reduced recharge

Understanding recharge rates and processes is critical to determining the sustainability of the resource. If surface and groundwater are highly connected, with groundwater replenishment happening through

yearly flooding, the system may be sustainable over the long term, even if groundwater is continuously pumped. However, seasonal drawdown jeopardizes water supply for crops; in Prey Veng, farmers experience that wells dry out at the end of the dry season. Drawdown can compromise village water supplies, particularly if water levels drop more than 6m below ground surface level (the depth at which hand pumps are no longer useful). If annual extraction exceeds annual recharge, then long-term water level decline, with gradual increase in pumping costs and eventual system failure.

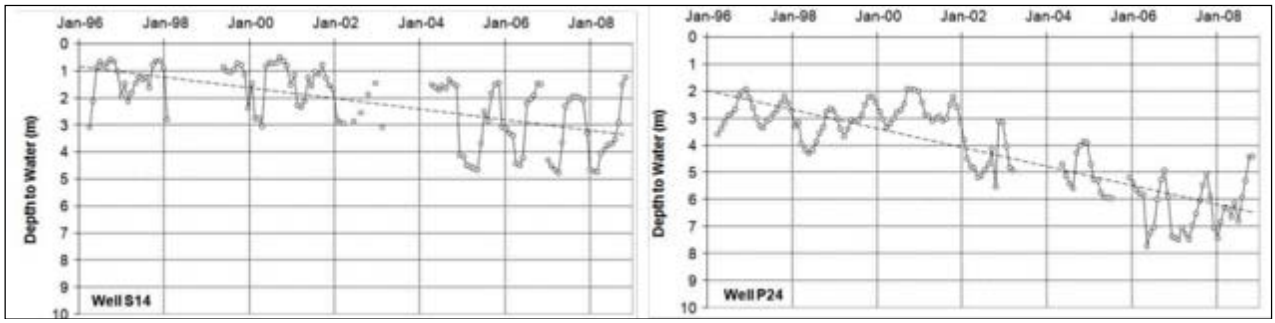


FIGURE 5. GROUNDWATER LEVELS IN PREY VENG & SVAY RIENG, 1996– 2008 (JOHNSTON, R., M. ROBERTS, T. TRY, AND SANJIV DE SILVA. 2013. *GROUNDWATER FOR IRRIGATION IN CAMBODIA*. COLOMBO, SRI LANKA: IWMI.).

iDE (2009) **observed average water level declines of 14cm/year** based on monthly water-level measurement in 49 wells in Prey Veng and Svey Rieng during 1996-2008 (Figure 5), suggesting that over pumping may already be a problem (Figure 6 and Figure 7). Figure 6 also explains that the main flow direction of groundwater is to the direction of Viet Nam, which is important for understanding aquifer recharge and for water quality concerns as discussed later. Declining groundwater levels have also been reported in Siem Reap, see Annex M3 for further details.

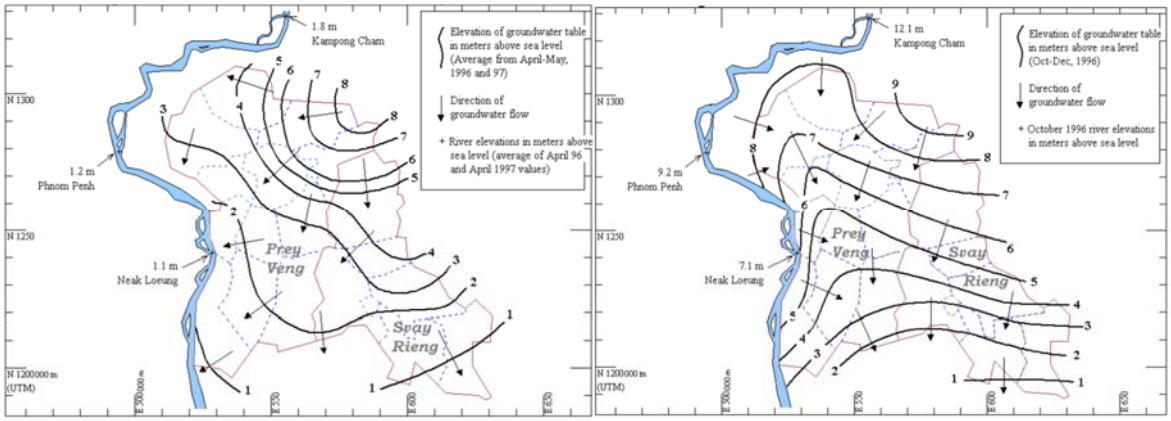


FIGURE 6. ELEVATION OF GROUNDWATER LEVEL IN THE DRY (LEFT) AND WET SEASON (RIGHT) (IDE CAMBODIA 2009. STRATEGIC STUDY OF GROUNDWATER RESOURCES IN PREY VENG AND SVAY RIENG (PHASE 1) FINAL REPORT. RURAL POVERTY REDUCTION PROJECT, SEILA TASK FORCE SECRETARIAT, IFAD LOAN NO: 623- KH, PHNOM PENH.)

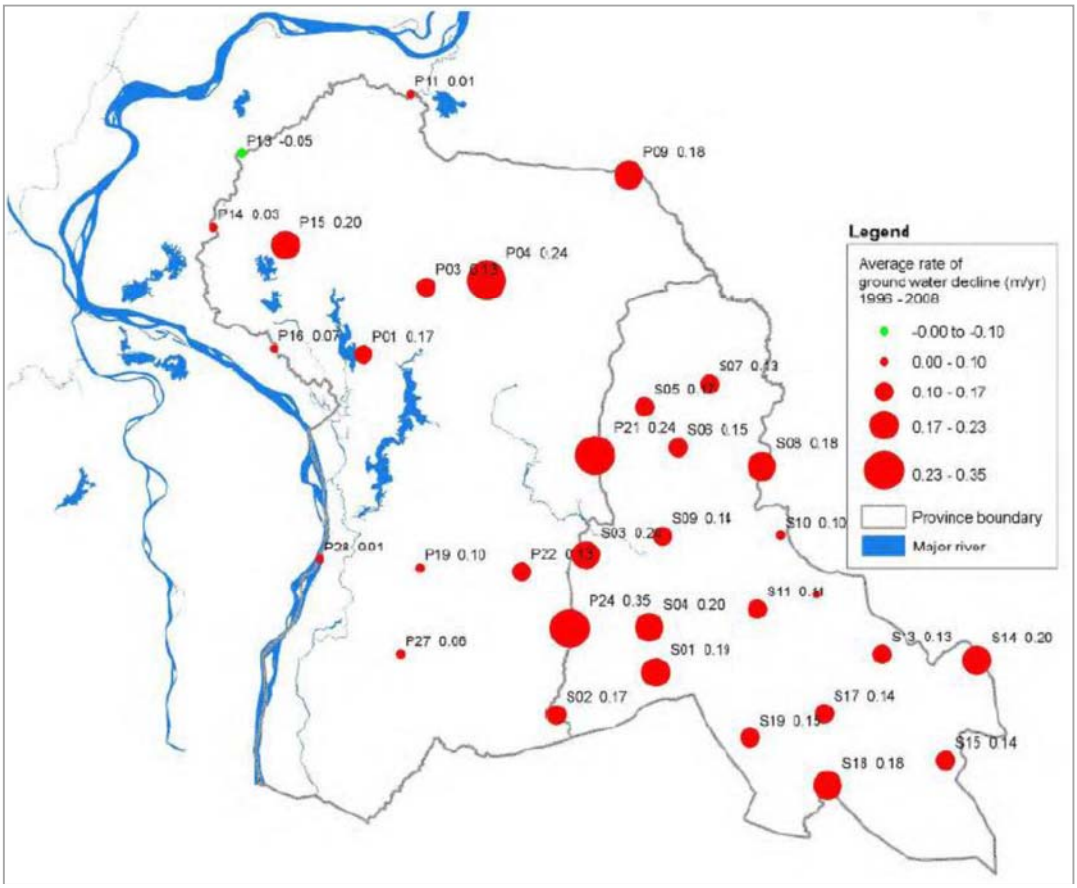


FIGURE 7. AVERAGE RATE OF GROUNDWATER DECLINE FROM APRIL 1996 TO DECEMBER 2008 IN SVAY RIENG PROVINCE. (IDE CAMBODIA 2009)

Monitoring data for Viet Nam's side of the aquifers indicate a clear trend of decline in groundwater levels. Annex M2 provides a detailed overview for monitoring data for the Mekong Delta.

TABLE 3: GROUNDWATER DECLINE IN VIET NAM'S MEKONG DELTA

Data for 2010	Holocone aquifer qh	*Upper Pleistocene aquifer, qp3*	*Upper-Middle Pleistocene aquifer, qp2-3*	*Lower Pleistocene aquifer, qp1*	*Middle Pliocene aquifer, n22*	*Lower Pliocene aquifer, n21*	*Upper Miocene aquifer, n13*
Average decline	0.064 m/a	0.15 m/a	0.30m/a	0.285m/a	0.434m/a	0.365m/a	0.266m/a
Extremes	HCMC: 0.34m/a	Can Tho & Tra Vinh: 0.27-0.39 m/a	Kien Giang, Tra Vinh, Ca Mau HCMC: 0.37-0.44 m/a	Ca Mau: 0.93m/a	Ca Mau: 0.89 m/a; HCMC: 0.78 m/year	Long An & Ca Mau: 0.81m/a	HCMC (Binh Chanh): 1.11m/a

Table 3 lists the average decline for each of the aquifer segments in Viet Nam's Mekong Delta. The sharpest average decline is 0.434 m/year for aquifer *n22*. However, several areas experience much more rapid groundwater decline, particularly in parts of Ho Chi Minh City and Ca Mau. These observations suggest that extraction levels from this aquifer (see Table 2) are highly unsustainable.

As aforementioned, climate change is an important driver that will continue to affect groundwater resources in the CDMA into the future. Overwhelmingly, research suggests that seasonal distribution of rainfall will change causing drier and longer dry seasons and shorter more intense wet seasons. Eastham et al., (2008) estimated the impact of climate change and hydropower dams on water resources in the

Mekong River Basin and predicted that by 2030, the mean annual runoff of the basin within the Cambodia territory would increase by 50-150 mm during the wet season. However, the percentage increase in annual runoff compared with the current condition is estimated to range between 10 percent (Tonle Sap) and 65 percent (Phnom Penh). Substantial increases in surface runoff during the wet season indicate that despite an increase of annual precipitation, groundwater recharge would not increase (or even decrease) because the large portion of rainfall would be lost via runoff, while further degrading soils. The impacts on runoff and groundwater recharge of climate change might be exacerbated without suitable management of current watersheds, catchments and flood plains.

Modelling for the Mekong Delta shows the likely future impact of climate change on groundwater recharge across three climate change scenarios, see Figure 8. This indicates that climate change is likely to start having larger impacts from 2040 on, which is a baseline scenario that is likely to unfold into a detrimental decline of aquifer recharge of 50-65 percent depending on the scenario.

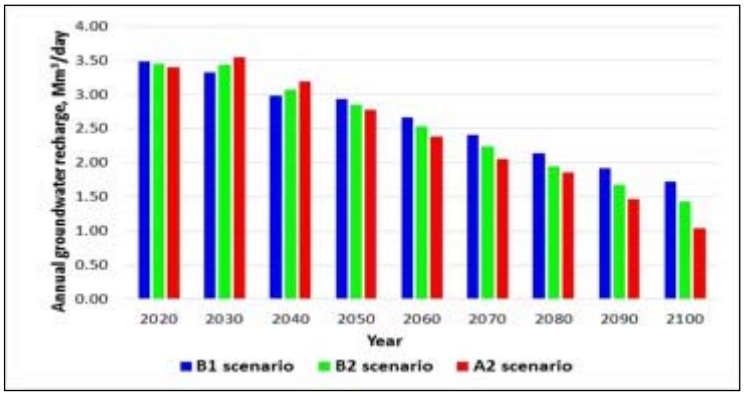


FIGURE 8. ANNUAL GROUNDWATER RECHARGE IN PERIOD 2020 TO 2100 UNDER THE THREE DIFFERENT CLIMATE SCENARIOS (VUONG B.T, 2014A)

Aquifer	Difference between GW levels in the year of 2010 and 2100, m		
	Climate scenarios		
	B1	B2	A2
qp3	8.1	8.5	10.3
qp2-3	14.5	15.0	17.4
qp1	4.9	5.5	4.8
n22	37.3	39.1	44.5
n21	1.6	1.5	1.5
n13	20.5	20.7	22.4

TABLE 4. DECREASE IN GROUNDWATER LEVEL UNDER DIFFERENT CLIMATE SCENARIOS (VUONG B.T, 2014A)

As a consequence, groundwater levels are likely to drop dramatically, as shown in Table 4. Under even highly optimistic assumptions (B1) critical aquifers will decline by 2010 by up to 37.3m (aquifer n22), 14.5m (qp2-3), and 8 m (qp3). These values increase to 44.5m (aquifer n22), 17.4m (qp2-3), and 10.3 m (qp3) if more realistic change scenarios are assumed.

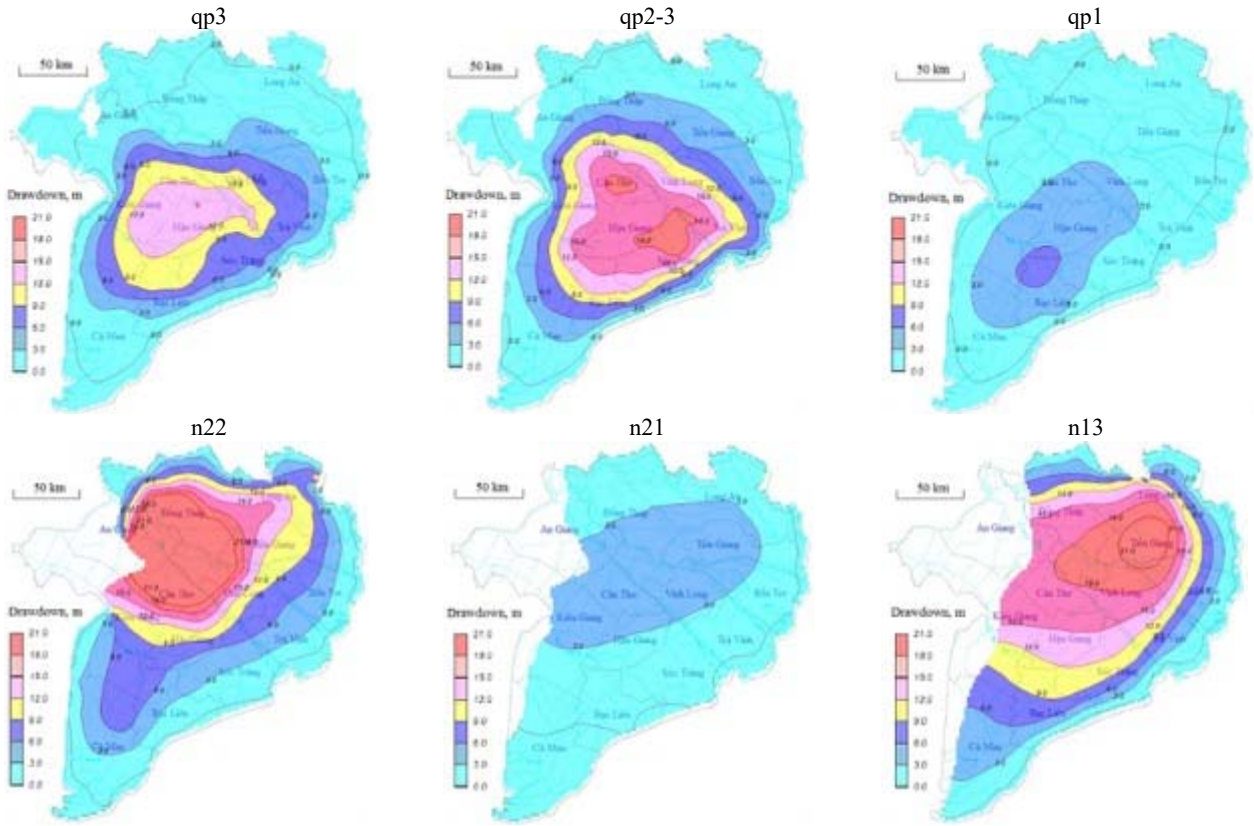


FIGURE 9. MAPS OF THE DIFFERENCES OF GROUNDWATER LEVELS IN 2010 AND IN 2100 AQUIFERS OF THE CMDA (CREATED BY AUTHORS)

Figure 9 shows that the average decline estimations will not occur uniformly but will have distinct geographic differences. Urban centers such as Can Thơ are likely to experience the largest decline. Most important for the transboundary context is that the largest drops in groundwater levels are likely to be seen in aquifers n22 and n13, which both lie across the border.

Land surface subsidence accelerated due to groundwater decline

Land subsidence is one of the major problems related to the over-extraction of groundwater. Land subsidence is especially of concern for aquifers of unconsolidated sediments, as a decrease in groundwater level reduces pore water pressure and in turn induces the compaction of unconsolidated sediment layers. The most imminent threat from land subsidence in Cambodia has been recorded for Siem Reap.

Siem Reap town is one of the fastest growing cities in Cambodia particularly fuelled by the tourism industry. At the moment, 16 000 m^3/day are pumped from wells south of West Baray while 18 000 m^3/day are pumped by hotels and water producton companies (see Annex M6) in Siem Reap city. All temples are built on sand layers. Their stability depends on the degree of water saturation. If these layers are not saturated, their stability decreases. *The high level of water abstraction represents a great threat to Angkor's world heritage listed temples.* Consequently, large areas in Siem Reap region experience moderate to rapid land subsidence, ranging from 5 to 12 mm per year.

Another Cambodian area facing the challenge of land subsidence is the Cambodian Mekong Delta. However, so far land subsidence has been minimal if compared to Viet Nam's parts of the Mekong Delta.

In Viet Nam's Mekong Delta, several studies have highlighted the threats posed by land subsidence due to groundwater over-extraction. Annex M3 provides a detailed overview. Erban et al. (2014) explains that the over-extraction causes an average decline of the hydraulic head of 26 cm/yr causing compaction-based subsidence rates average 1.6 cm per year (range: 0.28–3.1 cm/yr). InSAR-based estimates are very similar with a range of 1–4 cm/yr. Karlsrud and Vangalsten (2017) estimated the subsidence rate in Ca Mau at 2-4 cm/yr. Minderhoud et al. (2017) found subsidence rates of 6-20 mm yr-1 and determined based on long term monitoring (1991-2015) that the delta sank during this 25-year period on average ~170 mm due to groundwater extraction.

A study by the Ministry of Natural Resources and Environment involving 339 landmarks reaching from Ho Chi Minh City across the Mekong Delta (2014, 2015 and 2017) found subsidence rate ranging from 0.01 to 6.8cm/year, and an average of 1.07cm/year. Area with subsidence rates greater than 10cm covers an area of about 3 390km^2, including Ho Chi Minh City, Vinh Long, Can Thơ, Hau Giang, Soc Trang, Dong Thap, An Giang, Bac Lieu, and Ca Mau.

Recent research tested widely used elevation data and found that the average elevation of the delta plain (excluding areas with bedrock outcrops) is only 0.82m instead of the assumed 2.6m (according to the SRTM DEM). *Hence, the Mekong delta plain might well be the lowest elevated of all mega deltas in the world and even more vulnerable to sea-level rise than previously understood. Even a moderate sea-level rise (~40 cm by 2100 (Church et al., 2013)) would result a quarter of the delta falling below sea level by the end of the century.*

Groundwater quality – Arsenic threatens water security

Arsenic is the most concerning water quality issue for Cambodia and to some extent also in Viet Nam. WHO recommends a limit of 10 ppb and Cambodian drinking water quality standards define a maximum of 50 ppb. However, RDI monitoring reports arsenic concentrations of up to 3 000 ppb for Cambodia. Annex M4 provides results from a range of research studies for arsenic, manganese, iron, nitrate, and fluoride.

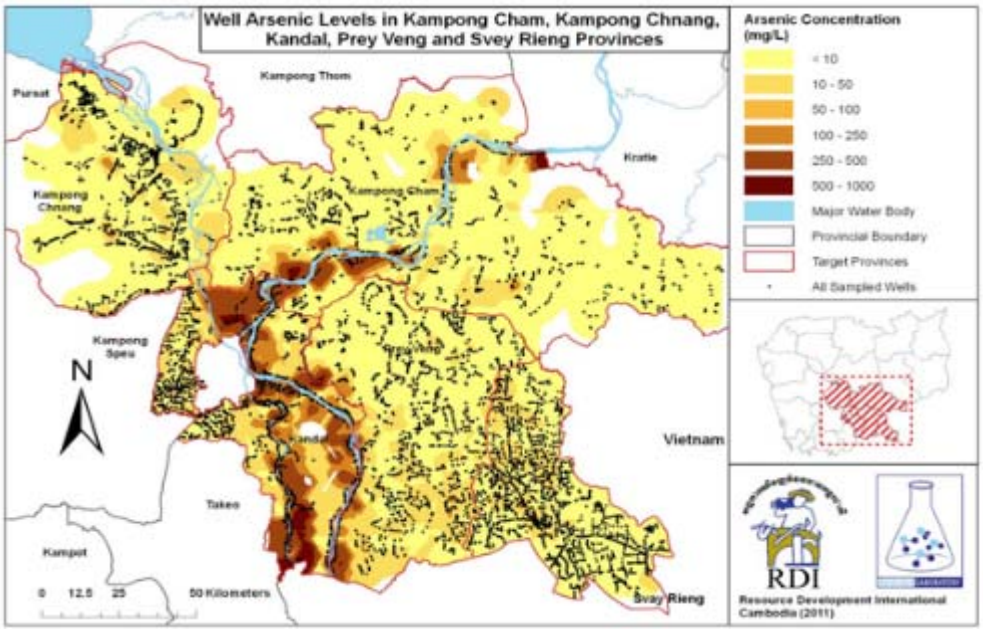


FIGURE 10. WELL ARSENIC LEVELS IN KAMPONG CHAM, KAMPONG CHNANG, KANDAL, PREY VENG AND SVAY RIENG (WHO LIMIT: 10MG/L) (RESOURCE AND DEVELOPMENT INTERNATIONAL,

CAMBODIA, SUMMARY OF GROUNDWATER QUALITY IN CAMBODIA, DATA, MAPS, AND PRIORITY PARAMETERS. 2011)

Groundwater arsenic pollution in the Mekong Delta is caused by reductive dissolution of arsenic-bearing iron phases buried in aquifers (Berg, at al, 2007). In Viet Nam's Mekong Delta various studies measured arsenic concentrations and peak values have been reported to reach 845 µg/L, 321 µg/l, 1 470 µg/L, or even 1 523 µg/L, depending on the location and the study. All studies confirmed that arsenic concentrations are only high within 100 m to both sides of rivers (see Figure 11) and that they can vary with seasons. Arsenic concentrations in January exceeded those in May and August.

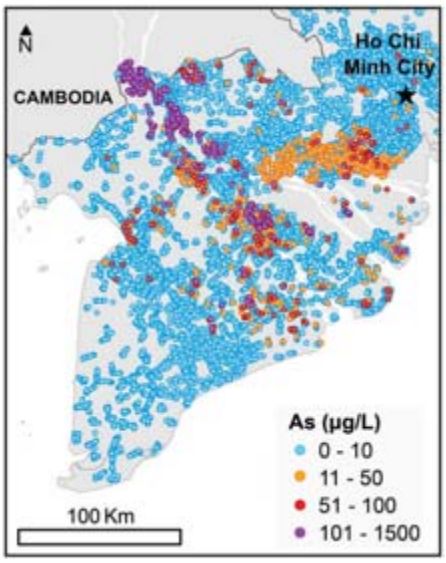


FIGURE 11. GROUNDWATER ARSENIC CONCENTRATIONS IN THE MEKONG DELTA, VIET NAM (SOURCE: ERBAN, L.E., 2013. GROUNDWATER EXPLOITATION AND ARSENIC OCCURRENCE IN THE MEKONG DELTA AQUIFER SYSTEM)

Most of the highest arsenic concentrations have been measured along the Cambodian border (see Figure 11) and considering the transboundary connection between the affected aquifers (Figure 6) it is likely that arsenic levels move across the border. Furthermore, groundwater extraction has been found to potentially unsettle arsenic concentrations, which is outlined in Annex M4, further aggravating the spread of arsenic.

Groundwater saline intrusion

Salinity intrusion is arguably the biggest water quality threat in Viet Nam's Mekong Delta (see Table 5 and Figure 12) and to some extend also in Cambodia's coastal communities. show. In Viet Nam's Mekong Delta 52 percent (for aquifer, n_2^1) and 88 percent (aquifer qh) of the aquifer area are saline.

TABLE 5. AREAS OF FRESH AND SALINE GROUNDWATER IN AQUIFERS

Parameters	Aquifer						
	qh	qp_3	qp_{2-3}	qp_1	n_2^2	n_2^1	n_1^3
Saline groundwater area, km^2	33 502	28 964	24 303	25 670	21 455	18 123	17 628
Fresh groundwater area, km^2	4 398	9 418	14 466	13 443	12 948	16 269	10 232

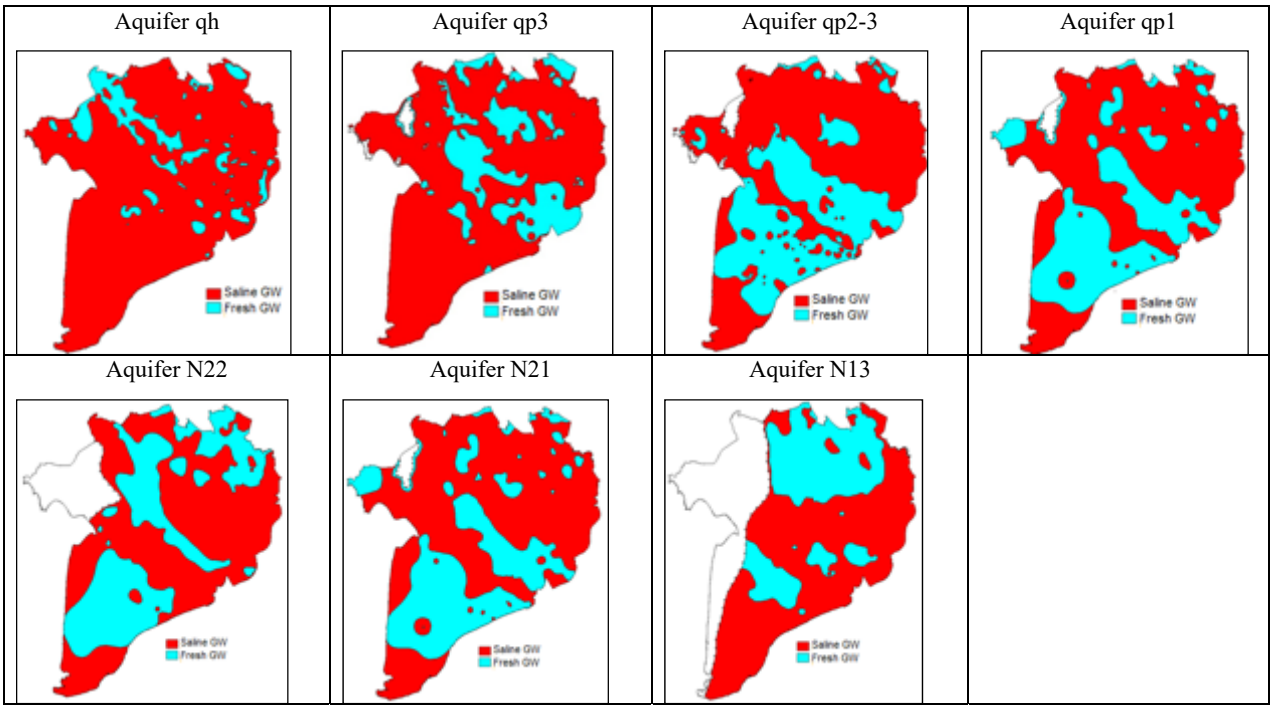


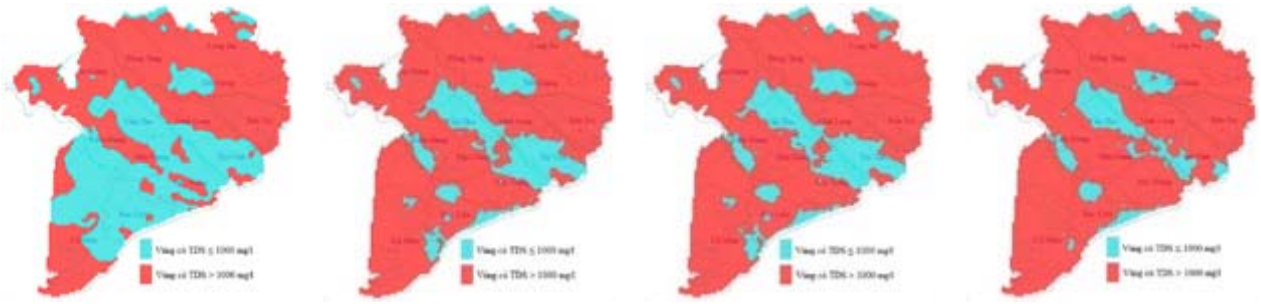
FIGURE 12. DISTRIBUTION OF FRESH AND SALINE GROUNDWATER (CREATED BY AUTHORS)

In Ben Tre province groundwater salinity is increasing due to shrimp farming, especially in communes of Binh Dai district. In Kien Giang province groundwater abstraction is very high while groundwater recharged is nearly absent, which causes salinity levels in groundwater to increase rapidly, like in Ha Tien, Rach Gia, An Ninh districts. In Soc Trang Province several abstraction wells are contaminated with salinity due to the phenomenon of leakage of salty groundwater or over-exploitation. The saline groundwater intrusion at the centralized water supply stations increased (at Dai Ngai town, Tran De district). In Tien Giang province most of the groundwater extraction wells at the depths from 20-100m are salty and the chloride content is many times above the allowable standards. In Hau Giang province the value of chloride content in groundwater increased sharply and exceeded Viet Nam's standard many times based on monitoring data for 2004 to 2010.

Saline groundwater is also widely observed in the Cambodian Mekong Delta, particularly in the coastal area, which is threatened by impacts of climate change (Smajgl et al., 2015), including seawater intrusion due to sea level rise. During the dry season, especially from November to February, seawater intrusion and high tides pose serious threats to land and freshwater sources in the coastal zone. Salinization of surface and groundwater has detrimental effects for local communities along the coast and can result in severe fresh water shortage (UNDP, 2009). Soil salinity of the coastal lands increases due to salt accumulation, which also has a severe impact on the fertility of the areas used for farming. A study indicated that in case of one-meter rise in seawater would result in inundation of 56 percent of Koh Kong city and an area of over 4 400 ha of natural habitat would submerge (MoE, 2005). Low-lying agriculture and urban lands have been affected by salinization, which would be further amplified by climate change. In addition, even a minor rise in sea-level will increase coastal erosion and may eventually lead to the inundation of economically important coastal infrastructure such as ports and coastal resorts. Even a moderate sea-level rise will increase flooding from storms and storm surges.

Salinity levels are also a problem in the south-eastern provinces of Prey Veng, Takeo and Kampot due to saline groundwater at the depth range of 40–50 m. Also, deeper groundwater abstraction for irrigation

in Takeo Province has failed due to intrusion of saline groundwater (ADB, 2013). Extraction limits could prevent salinization of groundwater and soil.
Figure 13 shows salinity changes for the qp2-3 aquifer, which is currently one of the most relevant aquifers for drinking water. While the most dramatic changes have to be expected for the southern provinces, effects are likely to impact also areas along and across the Cambodian border.



2010 | 2100, scenario B1 | 2100, scenario B2 | 2100, scenario A2

FIGURE 13. AREA OF SALINE GROUNDWATER IN AQUIFER QP2-3 IN 2010 AND 2100 UNDER DIFFERENT CLIMATE CHANGE SCENARIOS (CREATED BY AUTHORS)

Degradation of groundwater dependent ecosystems (e.g. wetlands)

A major environmental challenge in the context of declining groundwater levels is the sustainability of wetlands. Wetlands provide a multitude of ecosystem services, including flood risk mitigation and the provision of habitat for fish. Surface aquifers store water during the wet season and release it during the dry season to provide base flow for rivers, streams, and wetlands, thus providing an essential component of environmental flows. Floodplains are hydrologically complex, with a high degree of connectivity between surface and groundwater systems. Over-extraction of groundwater can reduce dry season discharge and, if water levels drop significantly, surface water bodies may lose water to the aquifer system rather than gaining from it. This can cause groundwater dependent wetlands to dry up, either seasonally or permanently. The implications for a wide variety of fish species and other aquatic species that depend on wetlands as nurseries and habitat can be severe and cause a further decline of fish population and diversity in the CMDA area. The ecological connectivity can cause losses across the wider lower Mekong basin. These consequences for fisheries will impact on the food security of millions of households.

Annex M5 provides an overview for groundwater dependent wetlands across the CMDA. On the Cambodian side more than 1.3m ha of wetlands depend on groundwater, many of international significance, including RAMSAR listed wetlands, e.g. Boeung Chhmar. Wetlands in Viet Nam's Mekong Delta cover 4 939 684 ha and are among the richest ecosystems of the basin, which provide important breeding sites for many aquatic species migrating to and from upper reaches of the Mekong River.

Particularly relevant for the groundwater context are riverine wetlands and lacustrine wetlands. Four sites within the Mekong Delta are Ramsar-listed wetlands, namely the Tram Chi National Park (listed in 2012), Ca Mau National Park (listed in 2013), Lang Sen Wetland Reserve (listed in 2015), and the U Minh Thuong National Park (listed in 2016).

The implications of groundwater decline on wetlands compound the other forms of degradation to which wetlands have been subject over many decades, including those resulting from drainage and

canal construction, and conversion for housing and farms. Now, only 1– 1.5 percent of the wetlands remain in the Mekong Delta.

Transboundary dimensions

Figure 14 below portrays the transboundary dimensions of the threats described above, underlining the need for an integrated, harmonized and coordinated transboundary approach. Red arrows depict negative causality, and blue positive causality. In summary, the main transboundary phenomena are as follows:

- Loss of forests and wetlands, and overall watershed degradation is reducing the recharge of the shared CMDA, with implications for groundwater availability in both countries;
- Modifications to surface hydrology (canals, sluices and reduced emphasis on flood-based farming) is reducing groundwater recharge in the shared aquifer;
- Over-extraction of groundwater for large-scale agricultural, domestic and industrial purposes in both countries is leading to depletion and reduced availability of the shared resource;
- Viet Nam in particular is affected by subsidence as a result of over-extraction of groundwater in both countries;
- Wetlands, especially those in Cambodia, are affected by groundwater decline, affecting the viability of transboundary fisheries resources of importance to both countries.
- Transboundary migration of (human) population is placing additional pressures on groundwater resources.

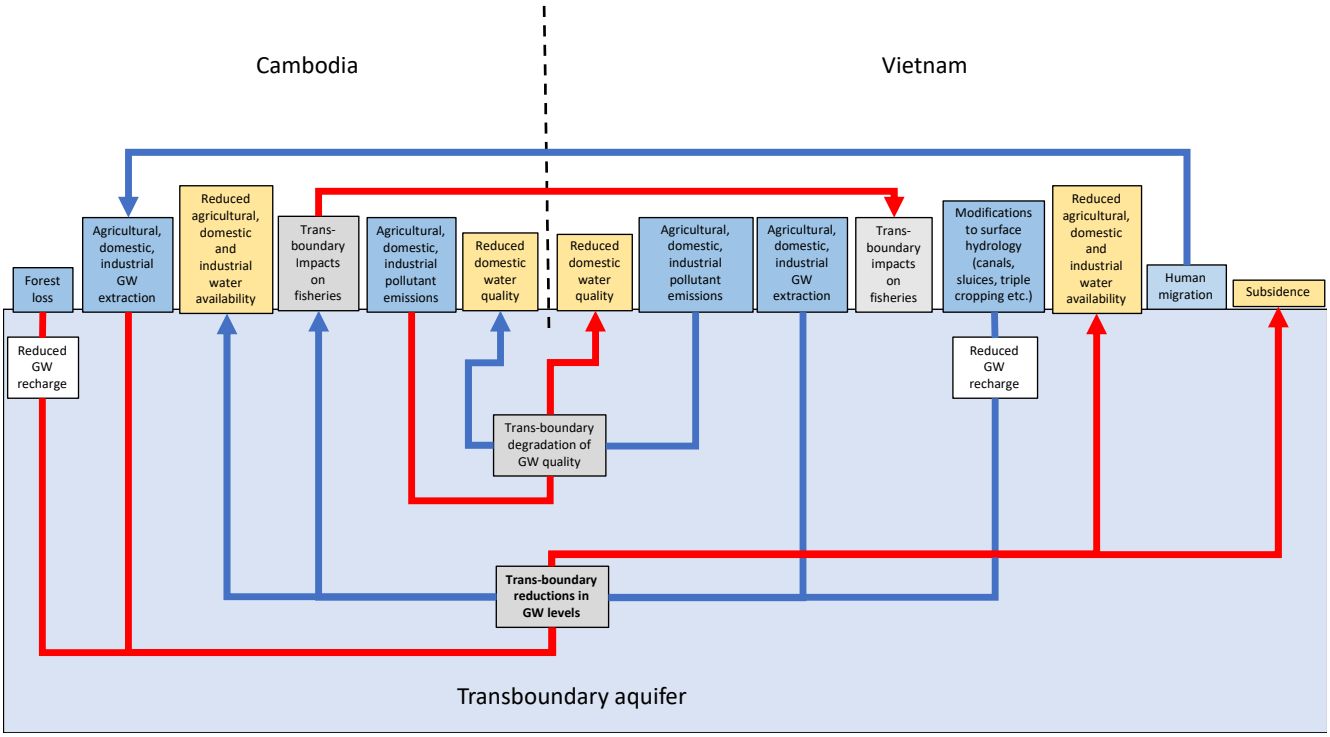


FIGURE 14: TRANSBOUNDARY DIMENSION OF THREATS TO CMDA (CREATED BY AUTHORS)

Socio-economic conditions and implications

The variety of interlinked bio-physical changes shift conditions for communities and affect a wide range of socio-economic indicators, including poverty and livelihoods. Annex M6 provides a detail overview for Cambodia while Annex M7 is focused on Viet Nam. Understanding the socio-economic dimensions reveals the actual exposure, vulnerability and risks for the dependent population to the biophysical developments, and reveals some of the major drivers for groundwater over-extraction and wetland loss. Ensuring sustainable dynamics between wetlands and the CDMA is critical for the survival of more than 16 million people as agricultural production systems of small-scale farmers, groundwater for domestic use, fish as main protein intake depend on this link.

In Cambodia 22 provinces and the capital city of Cambodia depend on the CDMA. Around 16 million people of which 51 percent are women live across the six different geographical regions with an average household size of 4.52, which converts to almost 3.5 million households including an average of 18 percent of female headed families (FHF).

The upper Mekong area is the least populated region but has the highest density of Indigenous Peoples (IP), which account for 10.25 percent of households. The main ethnicities are Kouy, Punong, Steang, Souy and Tompoun and follows by other Charay, Kanchork, Por, Merl, Krerl, Thmorn, Khernh, Chorng, Kreung, Sa Och, Kavet, Lun, and Rodai.

Poverty in Cambodia has been dropping due to rapid economic growth but it still ranks 146 of 189 countries on the UNDP Human Development Index (UNDP 2019). According to ID Poor (Ministry of Planning, MOP), an average of 14 percent of households (or 541 945 households) across all six regions of the groundwater aquifers of Cambodia are considered poor and highly depend on ecosystem services provided by wetlands. The COVID-19 pandemic already eliminated an estimated 390 000 jobs and is expected to push an additional 1.3 million people into poverty. As shown in the Mekong Subregional Report on the Rapid Gender Analysis conducted in 2020, women and children are disproportionately impacted, in particular related to financial impacts due to job and other economic losses, and an increase in their work-burden, as women might take on unpaid care responsibilities and domestic chores, including fetching water and collecting firewood. Furthermore, the under-representation of female share in decision-making and women's and children's needs in high level taskforces and committees might further exacerbate underlying gender inequalities.

Agricultural production in Cambodia involves 64 percent of the workforce or 5 million people, of which almost 4 million people cultivate rice. Rice production (3 871 689 ha) relies heavily on water and depends increasingly on irrigation. Subsistence agriculture is paramount for food provision of small-scale agriculture and for food security of the majority of households in the CMDA area.

The socioeconomic report from 2019 indicates that the currently 512 841 ha of rice are irrigated, of which 47.10 percent locate in the Lower Mekong region, specifically dry season land in Prey Veng, Takeo and Kandal. The Southern Tonle Sap region accounts for 43.03 percent of irrigated rice land but mainly for the rainy season, specifically for Battambang and Banteay Meanchey (Figure 15).

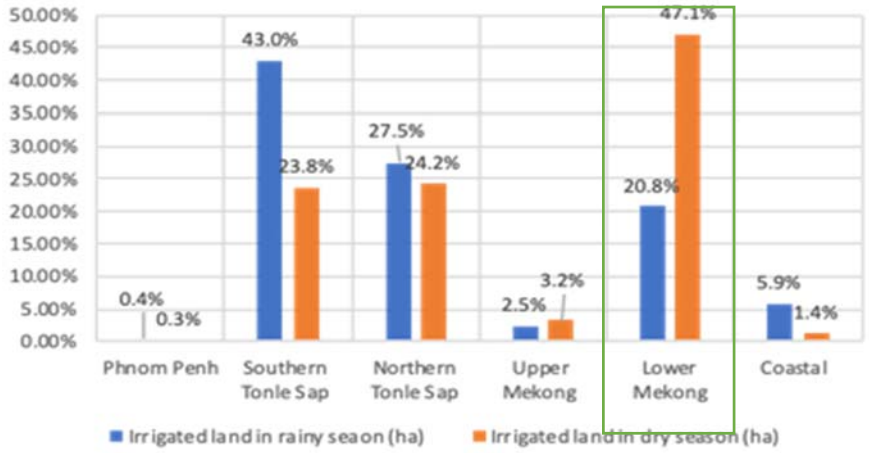


FIGURE 15: COMPARISON OF IRRIGATED RICE LAND IN RAINY AND DRY SEASON FROM THE SIX REGIONS (CREATED BY AUTHORS)

However, irrigation expansion plans aim to reduce community vulnerability to droughts. Establishing irrigation across the entire existing rice production across the CMDA (3 871 689 ha) would require an additional 2 942 048 ha of irrigation, especially in the Southern Tonle Sap (979 576 ha), the Lower Mekong (902 660 ha) and the Northern Tonle Sap (733 079 ha), see Figure 16.

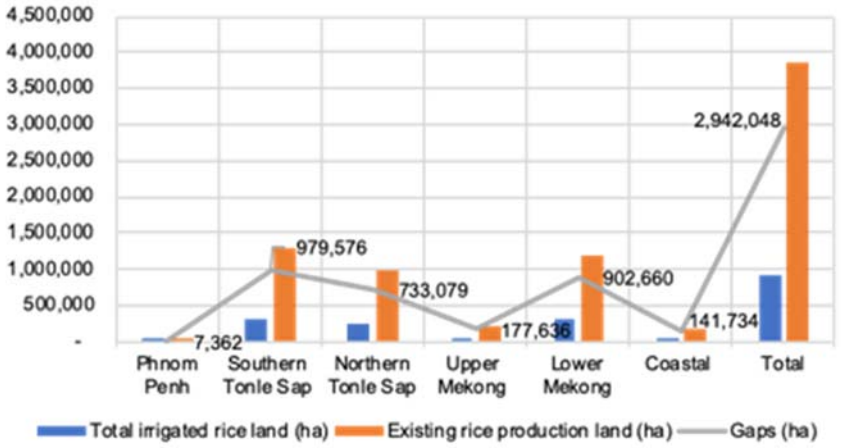


FIGURE 16: COMPARISON BETWEEN EXISTING RICE LAND AND IRRIGATED LAND FROM THE SIX REGIONS

The increasing number of non-agricultural water users further exacerbates water needs, in particular for pure water stations, hotels, and guesthouses.
Figure 17 shows that rural groundwater dependency seems highest in the Lower Mekong region with a large number of wells. Southern Tonle Sap uses substantially more rainwater than the other five regions.

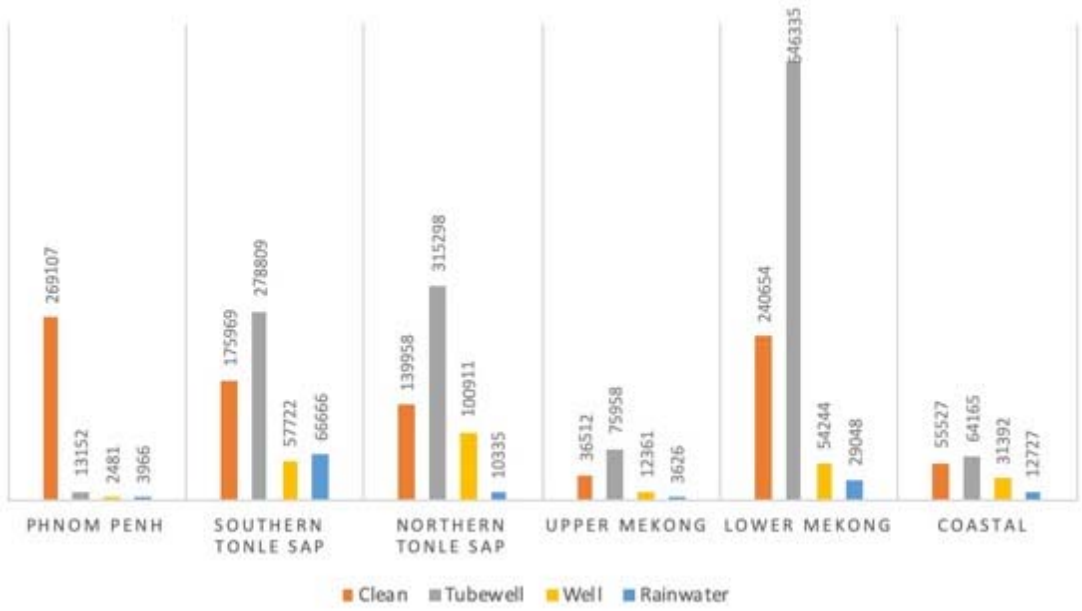


FIGURE 17: COMPARISON HOUSEHOLD'S ACCESS TO WATER SOURCES FROM THE SIX REGIONS (CREATED BY AUTHORS)

The emerging socio-economic picture highlights high groundwater dependency of households. Considering declining groundwater levels and the subsequent increase of pumping costs, it seems likely that particularly poorer population segments will become increasingly vulnerable.
On the Viet Nam side of the CMDA area, the mostly rural Mekong Delta needs to be distinguished from the largely urban Ho Chi Minh City area. It is estimated that around 21 million people live in the Mekong Delta while around 9 million people live in Ho Chi Minh City.
Livelihoods in the Mekong Delta depend widely on agricultural production, particularly rice and also increasingly shrimp farming. Rice income contributes 50-70 percent to the total income of richer farmers, compared to about 10-25 percent for poorer farmers. Poorer farmers typically supplement their income with fishing and off-farm wage labor, securing 45-55 percent of their total household income (Nhan et al., 2018).
In the coastal provinces, shrimp production has emerged as a major livelihood. However, saline shrimp production has economic and social trade-offs. Compared to rice and other crop production, saline shrimp production has higher income but bears high income loss risks due to shrimp diseases, less opportunities for off-farm employment and reduced food security of poor households (Smajgl et al., 2015). Shrimp culture requires relatively low labor inputs but reduces bio-diversity of aquatic resources, on which livelihoods of the poor highly depend.

Groundwater is a key input for many agricultural livelihoods, including aquaculture. However, groundwater related restrictions and poor water quality pose limits for agricultural as well as domestic users. Adoption of adaptive farming practices by farmers in response to these changes is still limited. A case study in the lower provinces by Hamer et al. (2019) reports that 84 percent of the farmers did not use improved water-saving techniques even though they believed a causal relation between groundwater extraction and the drop of groundwater levels. Main constraints are high material investments, poor access to information and education, and economical trade-off (Hoang et al., 2018; Hamer et al. (2019). Many farmers practicing upland crops (e.g. fruit trees, maize, water melon, groundnut) that rely on groundwater in Tra Vinh and Soc Trang provinces are too poor to change their farming practices, and they pay much more attention to short-term profit.

The use of rain water for domestic and agricultural purposes is still not popular, due to storage capacity and quality problems. A majority of groundwater users for domestic and crop irrigation purposes use privately owned tube-wells, which is constraint on resource management, efficiency and quality monitoring. Improved access to communal groundwater supply stations is therefore necessary to switch from private wells to communal supply systems (Danh and Khai, 2015).

Legal enforcement of small-scale groundwater exploitation by local authorities and inhabitants is weak. Groundwater use for agricultural purposes, with capacity > 10 m^3 per day and from the depth below 30 m, requires permission by local authorities (Decree 167/2018/NĐ-CP). However, drilling and extracting water from aquifers for agricultural uses by small farmers cannot be well controlled.

According to MDP (2013) and Resolution 120/NQ-CP (2017), regional land and water uses for agricultural development will be in the order of importance: aquaculture – fruit – rice (instead of rice – aquaculture – fruit formerly). Accordingly, flood-based farming production systems (i.e. rice and catfish) will be the main land use in the upper zone; fruits and high-value vegetables are major commodities in mid-zone; brackish and saline aquaculture production systems are important in the lower zone.

Summary of Barriers

The project will address the following barriers which, without GEF intervention, would prevent the transboundary problems affecting the CMDA from being addressed effectively. In summary, without GEF intervention the two countries would lack the level of shared understanding of the transboundary nature of the problems affecting the CMDA required to allow them fully to appreciate the need for transboundary cooperation; and they would lack the forum and methodological roadmap required for them jointly to develop negotiated and science-based solutions to their shared problems within the framework of a Strategic Action Programme (SAP).

Barrier 1: Lack of a shared, adequate understanding across the region of biophysical and socioeconomic conditions and processes associated with the CMDA

Description: At present, only fragmented and sectoral sets of data exist on the current state of groundwater resources, recharge and extraction dynamics. While monitoring of groundwater in Viet Nam is well developed, Cambodia lacks consistent and long-term national groundwater monitoring. Groundwater monitoring has only been performed by isolated groundwater resource assessment studies in certain regions. Cambodia lacks also data on deep wells (>78m); number of tube (dug) wells with hand pumps; quality of groundwater; and industrial groundwater use. Although aquifers on Viet Nam's side have been mapped, there is limited information on how far these extend into Cambodia, as required to identify transboundary impacts and inform transboundary management decisions. The deeper aquifers (n12-3) have in general been insufficiently studied. Aquifer system dynamics (seasonal and long-termed) is practically unknown. Socio-economic modelling that accounts for interactions between livelihoods of men and women, ecosystem services, environment, water resources, land use change, and migration remains absent, but need to be included for sustainable governance and management. Consequently, assessments of planning strategies, investments, or policies against a broader set of SDG indicators, and impacts of groundwater resource depletion on rural poor, are unavailable.

Impact: Without adequate data and modelling tool of the CMDA, groundwater management and underpinning policy and planning cannot lead to sustainable outcomes.

Project contribution: This project will address this barrier by among others, upscaling an existing (under Output 1.1 and Output 1.2) model of the CMDA (addressing piezometric and land subsidence evolution), updating and optimizing the monitoring network (under Output 3.1) and consolidating (under Output 1.3) a consistent TDA for the transboundary context of the CDMA.

<u>Barrier 2:</u> Limited knowledge across the region of proven strategies and practices for aquifer management and recharge

Description: Practical experiences of options for aquifer management and recharge are lacking, specifically in relation to practices for groundwater extraction, recharge and management. This is compounded by the lack of effective mechanisms for collecting, managing and channeling the learnings from experiences generated to date, into guiding decision-makers and practitioners.

Impact: Without the knowledge of proven strategies and practices investments face high risk and the design of actions remains paralyzed.

Project contribution: The project will present proven strategies including managed aquifer recharge (MAR) and test solutions as part of the demonstration project component, under Output 2.1.

<u>Barrier 3:</u> Inadequate cooperation on transboundary issues

At present, decisions and plans on groundwater/aquifer management are formulated on a country-specific basis: neither country has transboundary aquifer management obligations at present. Monitoring lacks transboundary harmonization. Moreover, the lack of data sharing agreement for groundwater resources is of particular concern in relation to key issues, such as groundwater levels, groundwater extraction rates, transmissivity, and in some areas salinity and/or arsenic levels. There is also limited coordination within countries on issues related to the management of the CMDA, especially between agricultural and environment sector institutions (such as DARD and DoNRE in Viet Nam), and between different provinces in the Delta.

Furthermore, mechanisms for transboundary resolution of conflicts associated with groundwater/aquifer management are lacking. Such conflicts include, for example, over-extraction of groundwater on one side of the border, affecting well yields on the other side, and potential transboundary movement of arsenic associated with such extraction.
In addition to the limited availability of data per se, there is limited consensus across the region on the nature and implications of the problems affecting the CMDA, particularly on issues of transboundary groundwater management and options of aquifer recharge strategies; nor are their objective, standardized and binationally-agreed measures specified in form of environmental indicators.

Impacts: This situation entails further risks leading to suboptimal or conflicting decisions being taken in relation to natural resource (including groundwater/aquifer) management.

Project contribution: The project will establish a TCCB for transboundary planning and coordination (under Output 3.3) and will also develop well-specified environmental indicators (under Output 1.4).

<u>Barrier 4:</u> Legal, policy, institutional and incentive frameworks do not specifically facilitate transboundary and inter-sector coordination

Description: The lack of shared vision of groundwater/aquifer management between the two countries, and of transboundary coordination of actions and investments, is further reflected in the

status of legal, policy, institutional and incentive frameworks. In addition to lacking transboundary focus, these frameworks generally fail to adequately consider the water-food-energy-ecosystems nexus.

So far, both countries have mainly focused on regulatory instruments instead of economic incentives (e.g. pricing instruments or subsidies) to manage groundwater aquifers. However, the implementation of legal documents related to water resources at bottom levels (i.e. district and commune) are not effective due to constraints of human capacity, financial budgets and sectoral coordination prevail. Additional barriers prevail between sectors affecting land use change and thereby directly and indirectly affecting groundwater resources.

Impact: Insufficient coordination between levels of governance and between sectors leads to fragmentation of planning affecting groundwater extraction and recharge directly or indirectly, for instance by lack of integrated land use planning.

Project contribution: The project will introduce as a demonstration project integrated land use planning (under Output 1.4) as well as improve capacity for cross-sector coordination for issues relevant for groundwater management (under Output 4.2 and 4.3).

Without overcoming these barriers, the CMDA is very likely to follow a highly unsustainable trajectory, as described in the following baseline scenario section.

2) The baseline scenario and any associated baseline projects.

As detailed above, without concerted transboundary groundwater management action the future trend is most likely to be characterized by

a) continued over-abstraction of groundwater resources in many parts of the aquifer, resulting in ground water level decline and land subsidence;
b) groundwater level decline will in turn incur environmental (e.g. loss of wetlands and loss of fish) and energy costs for pumping, which will threaten many livelihoods and increase poverty, disproportionally affecting women and children due to underlying gender inequalities.
c) Groundwater dependent ecosystems (wetlands) will be threatened, which will amplify water quality problems (e.g. nitrates) and erode livelihood, further adding to the poverty cycle.

The following paragraphs outline the five key threats: Groundwater level decline, land surface subsidence, groundwater saline intrusion, loss of groundwater dependent wetlands, and loss of ecosystem services provided in wetlands to rural livelihoods.

Challenge 1: Groundwater level decline

Large parts of the CMDA experience unsustainable levels of groundwater extraction while land use change and climate change cause aquifer recharge to decline. Consequently, groundwater levels are declining, in some areas rapidly, see Figure 7 and Table 3. Provinces in the Mekong Delta experience the highest decline, particularly Ca Mau Peninsula and Ho Chi Minh City, where groundwater in individual aquifer segments drops by around a meter per year. The future impact of climate change on groundwater recharge suggest a substantial decline of aquifer recharge of 50-65 percent. Consequently, groundwater levels are predicted to drop by up to 44.5m by 2100, see Table 4.
In Cambodia, groundwater decline is particularly extensive close to the border in Svay Rieng Province. Between 1996 and 2008, groundwater levels have dropped in average around 4.5 meters

and while no recent monitoring data was available the discussions during the project preparation phase have confirmed that this trend has continued and, in many places, even intensified. According to a study by Erban and Gorelick (2016), it was found that within 15 years current groundwater use in Cambodia will cause the groundwater table to drop below the level at which conventional suction pumps can operate. Considering the timing of this study and the accelerating extraction levels it is likely that many conventional suction pumps will run dry before 2030. Current observations flag that many pumps are already now drying up during the dry season. Cost and water security implications and subsequent impacts on the poor are substantial.

Challenge 2: Land subsidence

The lack of sustainable groundwater management has several major consequences of which land subsidence is often perceived as the most devastating. Land subsidence is understood to occur largely due to the decline of groundwater levels and the subsequent compaction of unconsolidated sediment layers. This phenomenon is most evident in Viet Nam's Mekong Delta and in Cambodia's Siem Reap Province. Several studies have focused on the Mekong Delta and observed land subsidence rates of up to 4 cm per year. In average, the delta sank between 1991 and 2015 by around 17 cm.
The BAU projections of future land subsidence have shown that the continuation of current groundwater extraction trends would cause a land subsidence of around 68 (55-70) cm by 2100 (Minderhoud, 2019). If extraction rates increase at a slightly higher rate of 4 percent, land is likely to subside by 1m or more by 2100. The severity of the situation becomes even more prominent if upstream hydropower development is considered. Minderhoud (2019) estimated that a sediment reduction of 50 percent over the 21st century results in a loss of elevation amounting to ~1.2 m at the present coastline due to ongoing natural compaction of the Holocene sequence. Recent MRC studies have alerted that sediment delivery might nearly entirely cease, leading to an elevation loss of ~2.0 m by the end of the century.

Challenge 3: Arsenic contamination

Arsenic contamination is a natural phenomenon that originates from alluvial deposits of major rivers which flow south and east from the Himalayas and the Tibetan plateau. The Mekong has received lower arsenic deposits than large parts of south Asia. Arsenic is released into alluvial aquifers when it reacts with organic matter and iron oxide. While the WHO prescribes a limit of 10 ppb some groundwater pockets in the CMDA exceed this limit by factor 300. The highest concentrations can be found in Cambodia in close proximity to the Mekong River. But also, Viet Nam experiences loads of up to 1 523 µg/L in localized pockets. However, while many deposits are currently localized the extraction of groundwater can spread arsenic contamination between affected aquifer segments or unsettle deposits and drive them according to the dominating flow direction towards Viet Nam's Mekong Delta.

Challenge 4: Groundwater salinization

Groundwater extraction and land subsidence will also induce salinity intrusion. This constitutes a mounting threat for crop production and subsequently for food security as yields of rice and other crops decline. Already now large parts of the coastal aquifer segments are considered saline. The portion of saline groundwater area varies from 52 percent to 88 percent depending on the aquifer segment. Unsustainable groundwater extraction and sea-level rise are key drivers for this threat. Some communities exacerbate groundwater salinization by increasing shrimp production and accelerating their groundwater extraction. Groundwater salinization is not only a threat to rice yields but also an

emerging threat for freshwater availability for millions of people in the Mekong Delta. These effects are not limited to coastal communities but reach north into Cambodia. Projections suggest that until 2100 the area of the seven aquifer segments that will be saline is likely to increase by up to 111km^2 per year.

Challenge 5: Loss of wetlands and loss of fish

The unsustainable extraction of groundwater and its implication for the decline of groundwater tables results in a loss of wetlands that depend on groundwater and a subsequent loss of fish that depend on wetlands as their habitat. Annex M5 provides an overview for groundwater dependent wetlands, which includes Ramsar-listed wetlands. As groundwater levels decline wetlands dry out. Typically, permanent wetlands turn into seasonal wetlands, only effective during the wet season, and with a further decline of groundwater tables wetlands can disappear. While some communities might experience the availability of land as a benefit, the long-term implications are typically substantial, as the frequency and magnitude of floods increase. Equally important, fish habitat disappears reducing the availability of fish nurseries for many fish species. This constitutes a substantial threat for food security of many communities in the CMDA area as fish provides the main basis for people's protein intake. Consequently, the disappearance of groundwater dependent wetlands and subsequent loss in fish and food security while flood risks are increasing constitute a major threat this project will address during the TDA-SAP process.

Socioeconomic implications

The social and economic consequences will result as a threat for the sustainability of the broader social-ecological system and the sustainability of the water-food-energy-ecosystem Nexus. In an early stage, stakeholders are likely to experience increasing pumping costs, as already observed in Cambodia and Viet Nam. Wealthier users will be able to respond with motoring wells, which shifts impacts disproportionately to the poorest users (Sekhri, 2014) , disproportionally affecting women's work burden by increasing their water-fetching responsibilities and by consequence restricts women's ability to invest in gaining skills, education, and to engage in entrepreneurial activities. These patterns are likely to affect in rural communities a wide variety of crops as well as livestock production. Increasing salinity levels will exacerbate the situation. Impacts will not be limited to agricultural uses but rather increase water scarcity and costs for all stakeholders, particularly under more realistic climate change scenarios, which involve increasing temperatures and heat waves. From a macroeconomic perspective, resulting public health related costs can be substantial (e.g. work force effects), a factor often neglected in water management.
The combined socio-economic effects of groundwater scarcity, land subsidence, salinity intrusion, and sea-level rise are likely to be catastrophic under the BAU scenario as millions will be forced to vacate inundated or uninhabitable areas. Consequences of the resulting migration are likely to be felt across many borders, first of all the one with Cambodia.

Government action and associated baseline projects

While the aforementioned baseline scenarios are daunting, both Governments have already started investing in a variety of actions, which will be described in the following Section, followed by a list of projects that will be implemented in parallel to this project. Following from there the alternative scenario will be outlined to summarize the contributions this project will be able to make.

<u>Baseline for Component 1</u> (Joint science-based diagnostic for groundwater dynamics (recharge and extraction) and effects on ecosystems (e.g. fish, wetlands) and livelihoods)

Research, monitoring and knowledge management

In recent efforts the Cambodian government focused on collecting data and improving monitoring to reach a better hydrogeological understanding of the CMDA. The Mekong River Commission aims to support these efforts with a new project that elicits agricultural groundwater extraction rates in Cambodia. Improving the monitoring of hydro-meteorological conditions in the country as well as improving existing water resources systems to cope with rapid climate change especially during dry season are of highest priority. Recently, the National Groundwater Strategy was enforced for Cambodia and will be executed by the Department of Water Supply and Sanitation in the Ministry of Water Resources and Meteorology in partnership with UNDP.
In addition, the Ministry of Rural Development of Cambodia with the support from various development partners such as ADB, World Bank, and UNICEF has started implementing significant actions on groundwater including:

1. A project funded by ADB, which has installed the groundwater monitoring network for regular monitoring of the groundwater dynamic changes throughout times and also increased utilization of groundwater resources for rural poor in Cambodia.
2. Development of groundwater map for some selected provinces.
3. Develop an arsenic database and mapping.
4. Mapping of groundwater aquifer in Svay Raing, Prey Veng, Kampong Cham, Kampong Chhnang, and Takeo provinces.
5. Establishment of local water use communities for all groundwater use-provinces for the long-term sustainability of groundwater utilization and promote equal opportunity and benefit-sharing among all water user and water use communities.
6. Promotion of gender mainstreaming in groundwater user groups and water use communities.
7. Annual expansion of wells for the rural community in the drought-prone areas in Cambodia.

In 2019, the Cambodian National Mekong Committee (CNMC) with the support of the Mekong River Commission has undertaken significant steps on executing the baseline study on groundwater in the Cambodian floodplain. This study supplies many good findings and a better understanding of the groundwater condition in the Mekong Basin and Cambodian floodplain for the preparation of the national strategic and development plan of the Mekong basin in Cambodia as well as the national indicative plan 2021-2025.

The domestic scientific agencies in Viet Nam (under MONRE and MARD) have carried out many series of research programs and projects on the management, exploitation and protection of groundwater resources in the Mekong Delta.

There has been cooperation between the scientific institutions of MONRE and MARD and the many international science organizations from countries such as Norway, France, India, etc., to study water resource management and development in general, which includes groundwater research in the Mekong Delta.

Since 2009 the German Ministry BMZ is funding the groundwater focused project “Improvement of Groundwater Protection in Vietnam” (IGPVN), which is being implemented in a partnership between the German BGR and Viet Nam’s NAWAPI/MoNRE. This study aims to improve the protection and sustainable management of groundwater resources in Viet Nam’s Mekong Delta assessing recharge, salinization, pollution, and land subsidence. Is has been recently extended until 2022 under the title

"Climate-resilient management of groundwater and geohazards". The project provides excellent data for two provinces in the Mekong Delta, Soc Trang and Ca Mau. During the PPG phase of this project the team already collaborated with NAWAPI and build on updated data and updated modelling provided by this BMZ project. This partnership will be continued during the TDA phase.

The ICRSL project also includes components implemented by MoNRE, which focus on improving the monitoring of surface and groundwater, the monitoring of riverbank and coastal erosion, and the establishment of a Mekong Delta Data Center. The World Bank's ICRSL investments focus solely on Viet Nam and does not include Cambodia. The establishment of a solid groundwater data base for the Mekong Delta is an important contribution to the improvement of groundwater governance in the Delta.

Few investments focus on land subsidence in Viet Nam's Mekong Delta. Ongoing investments in this field include the NWO funded project "Rise and Fall: Strategies for a subsiding and urbanizing Mekong Delta (Viet Nam)", which has a strong focus on improved groundwater modelling and salinity intrusion. The project's main goal is the development of a new Integrated Delta Model (IDM). The project aims to link surface water, groundwater and geo-mechanical models to analyze the interrelated character of groundwater extraction, subsidence levels and salt water intrusion (https://www.nwo.nl/en/research-and-results/research-projects/i/67/10967.html).

The BMBF funded project ViWAT is also triangulating groundwater extraction, land subsidence, and salinity intrusion in Viet Nam's Camau Peninsula, which involves the development of modelling capacity to predict surface and groundwater dynamics and effects on land subsidence in Camau (https://www.vd-office.org/en/viwat-mekong-go-2/). Related is BMBF's Catch Mekong project on salinity intrusion and sediment deposition in Viet Nam's Mekong Delta, which aims to fill data gaps regarding water availability, saltwater intrusion, land use, river morphology, and coastal erosion (https://catchmekong.eoc.dlr.de).

A major effort in regards to improving groundwater related data was the project "Solutions for Groundwater problems in the CCOP Region", which was a cooperation between CCOP, KIGAM and UNESCO in Bangkok. This project conducted a stock-taking exercise of all data available on all groundwater in the entire Mekong Basin, including the entire Cambodia-Mekong River Delta aquifer. The project involved a series of expert workshops to identify data availability and to synthesis the groundwater situation across the various aquifers in the Mekong basin. *The study revealed that the largest data gaps remain in Cambodia.*

The World Bank's Integrated Water Resource Management (IWRM) project invests in Cambodia and Viet Nam and covers a wide range of urban and rural topics. Its third phase is set to invest USD 16.5 million until 2021 on water management (quantity and quality), fisheries and agriculture. It includes investments in partnership with the MRC in five transboundary dialogue projects in the lower Mekong basin, which include one between Viet Nam and Cambodia focusing on river bank erosion, salinity intrusion, flooding (major focus), and sluice gate management. Groundwater is not included. Data sharing is a core goal of this transboundary initiative and a Joint Technical Committee (JTC) has been formed. *This initiative provides an important foundation for the CDMA project, which will involve that the TDA will systematically build on and further expand the data sharing experience of the World Bank investment and the SAP will reflect on the experiences made in the IWRM program.*

Table 6 features a summary of baseline projects relevant for Component 1. In yellow shading are the projects that include groundwater.

TABLE 6: BASELINE PROJECTS RELEVANT FOR COMPONENT 1

Current Projects	Investment & period	Area	Objective
MRC Council Study	USD 5.6m 2010-2017	Lower Mekong Basin, incl. Mekong Delta	Assessment of impacts of hydropower on surface water flow, sediment loads, and fisheries
Mekong Delta Study	2012-2015	Lower Mekong Basin with focus on Viet Nam's Mekong Delta	Assessment of impacts of hydropower on surface water flow, salinity intrusion, sediment loads, and fisheries
KIGAM funded project on the Mekong Delta aquifer	Until 2015	Entire Mekong Delta aquifer	Collaboration with UNESCO. Collate existing data on groundwater aquifer and make data policy relevant.
EU-PRASAC	1995-2000	All provinces	Monitoring groundwater by well network
BMZ funded "Improvement of Groundwater Protection in Vietnam" (IGPVN)	2009-2014 2015-2021	Soc Trang and Ca Mau Provinces in Viet Nam's Mekong Delta	BGR and NAWAPI partnership to improve protection and sustainable management of groundwater resources in Viet Nam's Mekong Delta assessing recharge, salinization, pollution, and land subsidence.
BMZ funded "Climate-resilient management of groundwater and geohazards"	2022-2026	Soc Trang and Ca Mau Provinces in Viet Nam's Mekong Delta	
World Bank's Integrated Climate Resilience and Sustainable Livelihoods (ICRSL) project	USD 310m Since 2016	Viet Nam's Mekong Delta	Monitoring of riverbank and coastal erosion, and the establishment of a Mekong Delta Data Center.
GEF/WB ICRSL (building on the phase 2016-2022, see above)	Start 2020	An Giang, Dong Thap (upper delta); Ben Tre, Tra Vinh, Vinh Long, Soc Trang (delta estuary); Ca Mau, Bac Lieu, Kien Giang (coastal peninsula)	GEF objective: strengthen research capacity, and encourage innovation relating to land and water management practices, and coastal forest rehabilitation to build climate resilience of agriculture and aquaculture livelihoods, and reduce greenhouse gas emissions
Groundwater mapping	Start 2018	Svay Raing, Prey Veng, Kampong Cham, Kampong Chhnang and Takeo	Mapping groundwater aquifer
World Bank's Integrated Water Resource Management (IWRM) project	USD 16.5m Third phase until 2021	Mekong Delta, Cambodia & Viet Nam	Data sharing is a core goal of this transboundary initiative and a Joint Committee has been formed
NWO funded "Rise and Fall" project	2014-2019	Viet Nam's Mekong Delta	Development of strategies for a subsiding and urbanizing Mekong Delta (Viet Nam) by modelling groundwater and salinity intrusion.
BMBF funded ViWAT project	USD 8m 2018-2021	Ca Mau peninsula in Viet Nam's Mekong Delta	The design and implementation of water management and land use change strategies, erosion control, land reclamation, and improved (ground) water and land subsidence monitoring.
BMBF funded Catch Mekong project	2013-2019	Viet Nam's Mekong Delta	Assessment of salinity intrusion and sediment deposition in Viet Nam's Mekong Delta to fill data gaps regarding water availability, saltwater intrusion, land use, river morphology, and coastal erosion.

DWRM study of coastal aquifers	2005-2008	Viet Nam's Mekong Delta	Assess coastal aquifers in Viet Nam's Mekong Delta and summarizes data and key trends.
IUCN project "Groundwater in the Mekong Delta"	USD 9 000 2011	Viet Nam's Mekong Delta	Build's on DWRM's study and adds other international research results for groundwater in Viet Nam's Mekong Delta.

***Baseline for Component 2:* Piloting solutions for improved transboundary groundwater management.**

Water/wetland management

Apart from the groundwater-related project, the Ministry of Environment in Cambodia, in cooperation with various development partners such as KfW, LMC, World Bank, and other national and local NGOs trying to conserve the wetland sites across the country for maintaining and balancing surface and groundwater recharge, regularly monitoring of surface and groundwater quality, and promote the conservation of environmental assets, improve better management of natural forest, promote reforestation and protect the major wetland sites which have significant ecosystem services and functions as well as establish almost a thousand of local communities for protection and conservation of natural forest, protected sites and wildlife sanctuary and so on.

There are two additional relevant World Bank projects in the Mekong Delta area, a new IDA project granted to the Cambodian Government (USD 91.7 million) to improve agricultural value chains, JICA's USD 266.9 million investment in improved water management in Ben Tre Province, and ADB's USD 100 million loan to improve climate resilience of farmers in the Mekong Delta by upgrading irrigation systems, which complements ADB's ongoing irrigations investment in Cambodia.

The European Union is supporting in Cambodia the project "Promoting of inclusive and sustainable growth in the agricultural sector: fisheries and livestock", which has the potential to enhance farmers' access to sustainable options for managing wetland-based livelihoods with positive implications for aquifer status.

Viet Nam's Government (via MARD) is also investing in a number of water management infrastructure projects, including Trà Sư sluice (USD 10 million), Ninh Quới ship lock combined sluice (USD 17.2 million), Xuân Hòa pumping station and sluice (USD 10.8 million), and the dredging of the Mây Phốp - Ngã Hậu canals (USD 19.7 million). Additional investments aim to improve irrigation schemes in Nam Bến Tre (USD 9.3 million), Cà Mau (USD 21.6 million), and Cái Lớn – Cái Bé (USD 142.7 million).

FAO's Sustainable Rice Landscapes projects in Viet Nam (GEF-7 FOLUR Impact Program) and Cambodia (LDCF) aim to scale-up best practices in rice farming. These projects do not focus on groundwater management. The proposed IW project will fill this gap and help make links between the three projects where relevant. The proposed IW project will draw on the biodiversity, ecosystem services, water quality and other assessments being undertaken for the other FAO projects as relevant.

Table 7 below summarises the baseline projects relevant for wetland management, highlighting in yellow those with groundwater elements.

TABLE 7: BASELINE PROJECTS RELEVANT FOR WETLAND MANAGEMENT UNDER COMPONENT 2

Current Projects	Investment & period	Area	Objective
USAID funded Mekong ARCC project	2011-2016 9.4 million USD	Kien Giang Province in Viet Nam's Mekong Delta	Improved management practice of rice-shrimp rotation farming.
ACIAR: Improving the sustainability of rice-shrimp farming systems in the Mekong Delta, Vietnam	2013-2020 2 129 516 AUD	Viet Nam's Mekong Delta	Improved management practice of rice-shrimp rotation farming.
RGC: Commune Investment Programme	2010-2030	25 Provinces	Water supply for community
EU-Capfish Capture (Aquaculture)	2019-2025 124 million USD	25 provinces	Aquaculture productivity and freshwater and marine fisheries
World Bank-Water Supply and Sanitation Improvement Project	2019-2024 57 million USD	Siem Reap	Provincial Water Supply and Provincial Sanitation Improvement
AFD-Project to Build the Bakeng Water Purification Plant and Expand the Drinking Water Network in Phnom Penh	2019-2022 177.33 million Euro	Phnom Penh	Water Purification Plant
ADB-Provincial Water Supply and Sanitation Project	2018-2023 123.74 million USD	Battambang, Kampong Cham, Siem Reap and Preah Sihanouk	Improved Pipe Water Supply and Sanitation
ADB-Urban Water Supply and Sanitation Project	2015-2022 34 million USD	Siem Reap, Stung Treng, Kampong Thom, and Svay Rieng	Improved and Established Water Supply System
ADB-Third Rural Water Supply and Sanitation Services Sector Development Program	2019-2024 47.48 million USD	Banteay Meanchey, Battambang, Kampong Chhnang, Kampong Speu, Kampong Thom, Kampot, Pursat and Siem Reap	Rural Water Supply including Tubewell, Ponds and Water Distribution System Development
ADB- The Agricultural Value Chain Competitiveness and Safety Enhancement Project	2020-2025 70 million USD	Kampong Cham, Kampong Thom, Oddar Meanchey, Preah Vihear, Siem Reap, and Tboung Khmum.	Provide access to high-yield, drought-resilient, disease-resistant crop seeds and other planting materials
World Bank-Cambodia Agricultural Sector Diversification Project	2019-2025 101.67 million USD	Country wide	Enabling agriculture diversification, supporting public infrastructure; Improving agriculture information systems and quality control management.
ADB-Irrigated Agriculture Improvement Project	2019-2025 120.76 million USD	Battambang, Kampong Cham, Kampong Thom and Takeo.	Irrigation System Development
ADB-Uplands Irrigation and Water Resources Management Sector Project	2016-2021 60 million USD	Battambang and Kampong Thom	Climate Resilient Irrigation System
World Bank's Landscape Project	2018-2021 6 090 831 USD	Viet Nam's Mekong Delta	Improved utilization of remote sensing technology to inform eco-tourism and improved road access.
IDA project "Cambodia Agricultural Sector Diversification Project"	2019-2025 91.7 million USD	Cambodia	Improved agricultural value chains and improved irrigation, involving surface and groundwater.

MARD, Viet Nam	2021-2025 221.3 million USD	Coastal provinces in Viet Nam's Mekong Delta	Improved water infrastructure, including sluice gates, pumping stations, and irrigation schemes.
ADB's Climate Resilience in Viet Nam's Mekong Delta project	2010-2017 100 million USD	Binh Thuan, Dak Lak, Dak Nong, Khanh Hoa, and Ninh Thuan Provinces in Viet Nam's Mekong Delta	Upgrading irrigation systems, involving the upgrade of pressurized pipe systems, the development of improved groundwater and water productivity assessments, and micro-irrigation systems.
ADB's Climate Resilience Cambodia project	2012-2017 7 million USD	Cambodia	Increased utilization of groundwater resources.
GEFTF/FAO Integrated Sustainable Landscape Management in the Mekong Delta (FOLUR ID) (GEF ID 10245)	2022-2027 5 354 587 USD	An Giang, Dong Thap (upper delta); Tra Vinh, Vinh Long, Soc Trang (delta estuary)	To incentivize scaling up of proven best practices and innovations for sustainable and inclusive rice-based production landscapes to generate a range of global environmental and livelihood benefits

Climate resilience measures

One of the largest investments is the World Bank funded Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods (ICRSL) project. Since 2016 around USD 310 million have been invested through the ICRSL program. Ten of its components are infrastructure-focused and are being delivered through the Ministry of Agriculture and Rural Development (MARD) and focus on flood drainage, livelihood adaptation, prevention of coastal erosion, and aquaculture improvements.

ICRSL aims to continue developing tools for effective climate adaptation in nine Provinces in Vet Nam's Mekong Delta. This program has no specific focus on groundwater management and does not include Cambodia.

The European Union is also supporting the project "Promoting climate resilient livelihoods for Small-Scale Farmers": this is primarily focused on drylands.

The World Bank project "Transforming the Mekong Delta" continues the Bank's aim to improve the resilience of livelihoods to floods and focuses on three provinces in Viet Nam's Mekong Delta. This initiative does not focus on groundwater and does not include Cambodia. Table 8 summarises baseline projects relevant for climate resilience under Component 2, highlighting in yellow those which included Groundwater.

TABLE 8: BASELINE PROJECTS RELEVANT FOR CLIMATE RESILIENCE UNDER COMPONENT 2

Current Projects	Investment & period	Area	Objective
WISDOM project	until 2013	Viet Nam's Mekong Delta	Flood and drought management
World Bank/GEFTF Integrated Climate Resilience and Sustainable Livelihoods (ICRSL) project (GEF ID 9265)	Since 2016 392 990 831 USD	Viet Nam's Mekong Delta: An Giang, Dong Thap (upper delta); Ben Tre, Tra Vinh, Vinh Long, Soc Trang (delta estuary); Ca Mau, Bac Lieu, Kien Giang (coastal peninsula)	Flood drainage, livelihood adaptation, coastal erosion prevention, aquaculture improvements, monitoring of surface and groundwater. Enhance tools for climate-smart planning and improve climate resilience of land and water management practices and encourage innovation relating to land and water management practices, and coastal forest rehabilitation to build climate resilience of agriculture and aquaculture livelihoods, and reduce greenhouse gas emissions
GEFTF/IUCN: Sustainable Management of Peatland Ecosystems in Mekong Countries (GEF ID 9232)	2016-2021 13 367 511 USD	Mekong basin incl Cambodia and Vietnam's Mekong Delta	To sustainably manage peatland ecosystems in targeted countries and to conserve biodiversity and reduce GHG emissions
GEFTF/FAO**:** Promoting Climate-Resilient Livelihoods in Rice-Based Communities in the Tonle Sap Region. *Under preparation.* (GEF ID 10177)	2022-2027 75 527 700 USD	Cambodia	Rice based communities in the Tonle Sap region of Cambodia reduce their climate vulnerability and increase their resilience to climate change through an ecosystem based, market driven approach
IFAD and RGC funded ASPIRE (national and provinces)	2014-2022 41.1 million USD	24 provinces and Phnom Penh	Support Agriculture extension service with climate resilient on horticulture, crops, livestock etc. Support Policy formulation and Policy planning on agriculture sector in Cambodia.
World Bank's Integrated Water Resource Management (IWRM) project	Third phase until 2021 16.5 million USD	Mekong Delta, Cambodia & Viet Nam	Riverbank erosion, salinity intrusion, flooding (major focus), and sluice gate management.
JICA's Water management project	2017-2022 266.9 million USD	Ben Tre Province, Viet Nam	To prevent salinity intrusion and ensure water distribution with adequate salinity level by constructing water sluices and related facilities
World Bank/GCF: Transforming the Mekong Delta (GCF project ID: P167595)	*in preparation* 40 million USD	Kien Giang, An Giang, Dong Thap (upper delta)	Scale up the transition of small-holder farmers to climate resilient livelihoods and strengthen their participation in flood-based value chains
World Bank IDA Mekong Delta Region Urban Upgrading Project	2012-2018 292 million USD	Viet Nam's Mekong Delta	Upgrading drains, canals and roads in response to climate change (e.g. sea-level rise, flood & drought management)

<u>Baseline for Component 3:</u> Transboundary cooperation mechanisms

There has been cooperation in research, sharing information on water resources and sustainable development of water resources with countries in the cooperation frameworks of Mekong River Commission (MRC), Lancang-Mekong Cooperation Mechanism (LMC); Greater Mekong Subregion Cooperation (GMS). Cambodia and Viet Nam are both members of all of these cooperation mechanisms.

<u>Baseline for Component 4:</u> Joint strategies and action programs

Legislative and policy frameworks

Besides many significant signs of progress of groundwater investment project, the Royal Government of Cambodia (RGC) has developed several important legislative documents to ensure the efficiency of water uses and water management including the groundwater in Cambodia including:

1. Endorsement of National Law on water resources management in Cambodia has been enacted on 29 Jun 2007 and approved 5 sub-decrees subsequently supporting the operationalization of the water law of 2007.
2. Endorsement of National Strategy for Rural Water Supply in 2011-2025
3. Endorsement of the water supply and sanitation regulatory law for Cambodia
4. Approved the National Groundwater Strategy for Cambodia

Legal framework: Central and Province Governments have issued a range of legal documents to improve the management of groundwater resources in the Mekong Delta. This includes at the *central level:*

- The Government's Decree "Regulations on restricting groundwater exploitation" (2018).
- The Government's program on research and processing of information on groundwater exploitation and the risks it poses for land subsidence in the Mekong Delta (2019).
- The Ministry of Natural Resources and Environment (MONRE) support of the Project "Investigation and evaluation of the exploitation and use of groundwater, impacts on land subsidence in the urban area. Hanoi City, Ho Chi Minh City, Mekong Delta, orientations for management, exploitation and sustainable use of groundwater resources" (2017).
- MONRE program on "Regulations on the protection of groundwater in the activities of drilling, digging, exploring and exploiting groundwater (2017).
- MONRE program on "Regulating the classification and requirements in conducting investigation and assessment of groundwater resources" (2018).
- MONRE program on "Regulating the practice of groundwater drilling" (2014).

At the provincial level it is critical to highlight that all provinces in the Mekong Delta and Ho Chi Minh City have had issued their legal documents on groundwater exploitation and use in the province, some of them are listed below:

- Ho Chi Minh City: "Decision on Promulgating the plan to reduce groundwater exploitation and filling up underground wells in Ho Chi Minh City by 2025" (2018).
- Soc Trang province: "Decision on the Regulation on the authority to organize the registration of groundwater exploitation in Soc Trang province" (2017).
- Long An province: "Directive on the strengthening management and exploitation of groundwater resources in Long An province" (2016).

- Ca Mau province: "Resolution on the fee for granting permits for groundwater exploration, exploitation and use; exploitation, use of surface water and discharge of wastewater into water sources and irrigation works in Ca Mau province" (2015).
- Tien Giang province: "Resolution on regulating rates of collection, management and use of fees for appraisal of the projects, the reports of exploration, exploitation and use of groundwater; exploitation and use of surface water; wastewater discharge into water sources in Tien Giang province" (2014); "Resolution Stipulating rates, collection, payment, management and use of fees for appraisal of projects, reports on exploration and assessment of reserves, exploitation and use of groundwater in Tien Giang province" (2020).
- Kien Giang province: "Resolution of Regulating fees for appraisal of projects, reports on exploration and assessment of reserves, exploitation and use of groundwater; fee for assessment of project on exploitation and use of surface water and seawater; evaluation fee for wastewater discharge project into water sources and irrigation works in Kien Giang province" (2018).
- An Giang province: Resolution of Regulating the rates, collection, exemption, payment, management and use of the project evaluation fee, reporting results of the exploration and evaluation of groundwater reserves, An Giang province" (2018).
- Dong Thap province: 'Resolution of Regulating the rate, collection, payment, management and use on the evaluation fee for the project of exploration and exploitation of surface water and groundwater environmental impact assessment, improvement and restoration of the environment in Dong Thap province" (2016).
- Bac Lieu province: "Directive on strengthening the management of exploitation and practice of groundwater drilling in Bac Lieu province" (2008).
- Can Thơ city: "Decision on Appraisal fee for projects, reports on exploration, exploitation and use of groundwater; exploitation and use of surface water; discharge of wastewater into water sources, irrigation works" (2008).
- Kien Giang province: "Resolution on Promulgating a list of fees for evaluation of projects, reports on exploration, exploitation and use of groundwater; exploitation and use of surface water; discharging wastewater into water sources and irrigation works in Kien Giang province (2017)".
- Long An province: "Decision on Promulgation of regulations on the management and licensing of exploration, exploitation and practice of groundwater drilling" (2004).

In Viet Nam two major development frameworks have been developed, the Mekong Delta Plan (2013) and the Prime Minister Resolution 120 (2017), which receive substantial financial support by various donors.

TABLE 9: BASELINE PROJECTS RELEVANT FOR POLICY FRAMEWORKS UNDER COMPONENT 4

Current Projects	Investment & period	Area	Objective
IFAD and RGC funded ASPIRE (national and provinces)	2014-2022	24 provinces and Phnom Penh	Support Policy formulation and Policy planning on agriculture sector in Cambodia.

Resource planning

Viet Nam's Government is well aware of the various facets of groundwater related problems and have invested in improving the management of groundwater in the Mekong Delta. The Ministry of Natural

Resources and Environment acknowledges that excessive groundwater extraction is one of the causes of land subsidence in the area of Ho Chi Minh City and the Mekong Delta. Currently, the main focus is on adjusting development plans to mitigate emerging risks related to land subsidence and the design of more effective regulatory mechanisms to curb groundwater extraction. Central and Provincial Governments have taken many actions to improve groundwater resources in the Mekong Delta.
The Mekong delta Integrated Region Planning for the period of year 2021-2030 with a vision to the year of 2050 - in which water resources are considered as the foundation for the sustainable and prosperous development of the Mekong Delta (WB loan).

TABLE 10: BASELINE PROJECTS RELEVANT FOR RESOURCE PLANNING UNDER COMPONENT 4

Current Projects	Investment & period	Area	Objective
Mekong Delta integrated Regional Planning in period of 2021-2030 and vision to 2050	USD 10 million 2019-2021	Mekong delta in Viet Nam	Promoting the rational use of resources to ensure compliance with the characteristics of land / water resources • Encourage the sustainable use of water resources under the motto "living with fresh water, brackish water and salt water". • Reduced groundwater extraction and excessive sand exploitation. • Encourage natural and man-made systems to be more resilient to the impacts of climate change and upstream development activities. • Strengthen management and control of environmental pollution (water, land and air). • Restore terrestrial and aquatic ecosystems biodiversity. • Promote sustainable production and environmental quality of products.
IUCN's Integrated Planning Project Viet Nam project	until 2018	Viet Nam's Mekong Delta	Also focusing on flood mitigation but with a strong biodiversity and land use planning component was
Australian Aid funded Mekong Delta Futures project	Until 2014	Viet Nam's Mekong Delta (and basin wide)	Improved land use planning based on the impact assessment of upstream hydropower development, sea-level rise, and climate change.

Resource governance

Institutional aspect: The Ministry of Natural Resources and Environment (MONRE) (Central) and the Departments of Natural Resources and Environment (DARD) (Province) are assigned with "Zoning and announcing restricted areas, restricted groundwater extraction zones, areas to be supplemented. artificial groundwater, minimum flow, threshold for groundwater extraction as prescribed by law; to guide the implementation of the regulations on the establishment and management of water source protection corridors according to the provisions of law; determine and announce the sanitary protection area of the area where domestic water is taken.

TABLE 11: BASELINE PROJECTS RELEVANT FOR RESOURCE GOVERNANCE UNDER COMPONENT 4

Current Projects	Investment & period	Area	Objective
Enhancing Local Water Government in Mekong delta (UNDP – VNWP)	2020-2021	Mekong delta in Viet Nam	The UNDP GoAL-Waters (Governance, Accountability, and Learning for Water Sustainability) programme supports equitable, efficient and environmentally sustainable use and protection of freshwater and marine resources. It helps in identifying priorities and opportunities and addressing gaps and constraints in water and ocean governance by developing policy reform plans and actions at national and local levels. It supports the 2030 Agenda with an emphasis on SDG6 to "Ensure availability and sustainable management of water and sanitation for all" and SDG14 to "Conserve and sustainably use the oceans, seas and marine resources for sustainable development."

Summary of the baseline (without project) scenario

The information on baseline projects presented above emphasizes that while substantial investments have targeted specific water related challenges in the Mekong Delta (groundwater decline, land subsidence, salinization, loss of wetlands and fish), only minor portions of current and proposed funding focuses on groundwater. These few initiatives are limited to the Mekong Delta and aim to establish a solid data base on groundwater and inform a few emerging modelling initiatives. No previous, existing or planned initiative is explicitly focused on the entire Cambodia - Mekong River Delta aquifer or aims to establish transboundary cooperative frameworks for aquifer management between Cambodia and Viet Nam. However, transboundary cooperation is essential for effectively addressing groundwater related concerns, including water security and land subsidence. The objective of the proposed project is fill this gap and strengthen environmental sustainability and water security in the Lower Mekong Basin by focusing on improved governance and sustainable utilization of the CMDA.

While on the one hand, the proposed initiative benefits from past and ongoing studies as data is increasingly available for the evidence-based decision making which underpins understanding of transboundary dynamics between both countries, on the other hand establishing an aquifer-focused transboundary cooperative process between Cambodia and Viet Nam is likely to generate substantial benefits for both ongoing and planned initiatives. Generating cross-project synergies will be a major objective of this proposed IW project.

TABLE 12: MAIN CHALLENGES AND RESPONDING PROGRAMS IN THE CMDA AREA

Challenge	Key drivers	Investment focus		
		Research/Data/ Monitoring/Modelling	Implementation (Livelihoods or infrastructure)	Transboundary cooperative frameworks for groundwater management
Land subsidence Lowering of the water table Salinity intrusion	Groundwater over-extraction; Sea-level rise; Land use change; Infrastructure development; Upstream hydropower development	KIGAM (CA&VN); BMBF (VN); IUCN (VN); MARD (VN); MoNRE (VN); many independent studies (mostly, VN; e.g. Mekong Delta Futures)	VN Gov (limited) JICA (VN); MARD (VN); MoNRE (VN)	
Floods	Climate change; Upstream hydropower development	MRC (VN&CA); MARD (VN); MoNRE (VN); WISDOM (VN); independent studies (mostly VN)	WB ICRSL (VN) & RUUP (VN); ADB (CA); MARD (VN); MoNRE (VN)	
Sustainable land use & land restoration	Salinity intrusion; floods; climate change	FAO (VN); IRRI (VN); MARD (VN); MoNRE (VN)	FAO FOLUR (VN)	
Groundwater quality degradation	Pollution from anthropogenic sources			
Loss of groundwater dependent ecosystem services	Reduced aquifer recharge and groundwater quality			

Table 12 maps current and planned investments against the sustainability challenges in the region. It clearly highlights the critical lack of comprehensive action to address groundwater related challenges and opportunities. Activities to develop a transboundary framework to address these challenges do not yet exist. The project proposed here aims to fill this critical gap.

3) The proposed alternative scenario with a brief description of expected outcomes and components of the project and the project's Theory of Change.

The proposed foundational IW project will seek to strengthen environmental sustainability and water security in the Lower Mekong Basin by investing, for the first time in the region, in the totality of the Cambodia-Mekong River Delta transboundary aquifer present in the subsurface of the entire region, on the understanding of its functioning and interactions with surface waters and ecosystems, and on its national and transboundary governance. The project will place emphasis on the enhancement of aquifer recharge, pollution reduction, and optimization of groundwater withdrawals. This is expected to be achieved by:

- Strengthening transboundary cooperation through joint fact finding and information exchange;
- Harmonizing technical capacities and the level of understanding of the aquifer's functioning across the two countries;
- Enhancing groundwater recharge through the introduction of sound groundwater governance frameworks and practices (e.g.: protection of recharge areas), building on the results of the FAO/GEF Global Groundwater Governance project;
- Promoting the application of effective nature-based solutions and technologies (new to the CMDA area) to optimize groundwater use, reverse salinization trends and increase resilience to climate change (e.g.: Aquifer Storage Recovery and Reuse – ASR/MAR; demand management);

- Identifying major groundwater challenges through Aquifer Vulnerability mapping and demonstrating solutions to mitigate related risks, e.g. agricultural pollutant contamination
- Improving the management of freshwater dependent ecosystems by unravelling the role of groundwater in sustaining their functioning and reversing the groundwater decline;
- Facilitating policy coordination with relevant sectors especially at national level, in particular with policies for surface water management, sustainable land-use planning, agriculture (including food securirty for the rural population) and energy.

The proposed project - targeting the main aquifer of the Lower Mekong Basin shared by Viet Nam and Cambodia - will complement the recently approved GEF-World Bank project: *Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods*, and its related IDA loan, and other ongoing initiatives, by:

- Addressing for the first time the groundwater component of the hydrologic system of the Lower Mekong in its entirety, including the critical upstream Cambodian section with its groundwater related freshwater ecosystems and recharge areas controlling subsurface water flow to the delta. This will be achieved using a state-of-the-art model;
- Reinforcing the countries' institutional capacity in groundwater governance, including socio-economic aspects;
- Creating the enabling environment and policy frameworks for transboundary cooperation in the management of the shared aquifer resources and dependent ecosystems and ecosystem services for the rural population.

The project will support countries as they go through the Transboundary Diagnostic Analysis – Strategic Action Program (TDA-SAP) methodology recommended by the GEF IW Focal Area for "foundational" projects, aimed at creating mutual trust among riparians by joint fact finding, facilitating the consensus on overall long-term basins visions, and assist governments and stakeholders as they agree on the strategies and actions needed to reverse degradation trends and move towards water security. The project will fulfil its purpose through the systematic implementation of structured participatory processes for institutional strengthening, awareness raising, promotion of broader adoption, and gender mainstreaming designed to identify the procedures, agreements, responsibilities and monitoring strategies for successful cooperation between the two countries and the multiple sectors dependent on the shared aquifer system. This will strengthen transboundary aquifer management capacity and lead towards the institutionalization of transboundary cooperation. The entire project will be gender-mainstramed through a tailored gender integration and equality approach described in Annex N2. The intervention logic is outlined in Figure 18 while the detailed Theory of Change is shown in Figure 19.

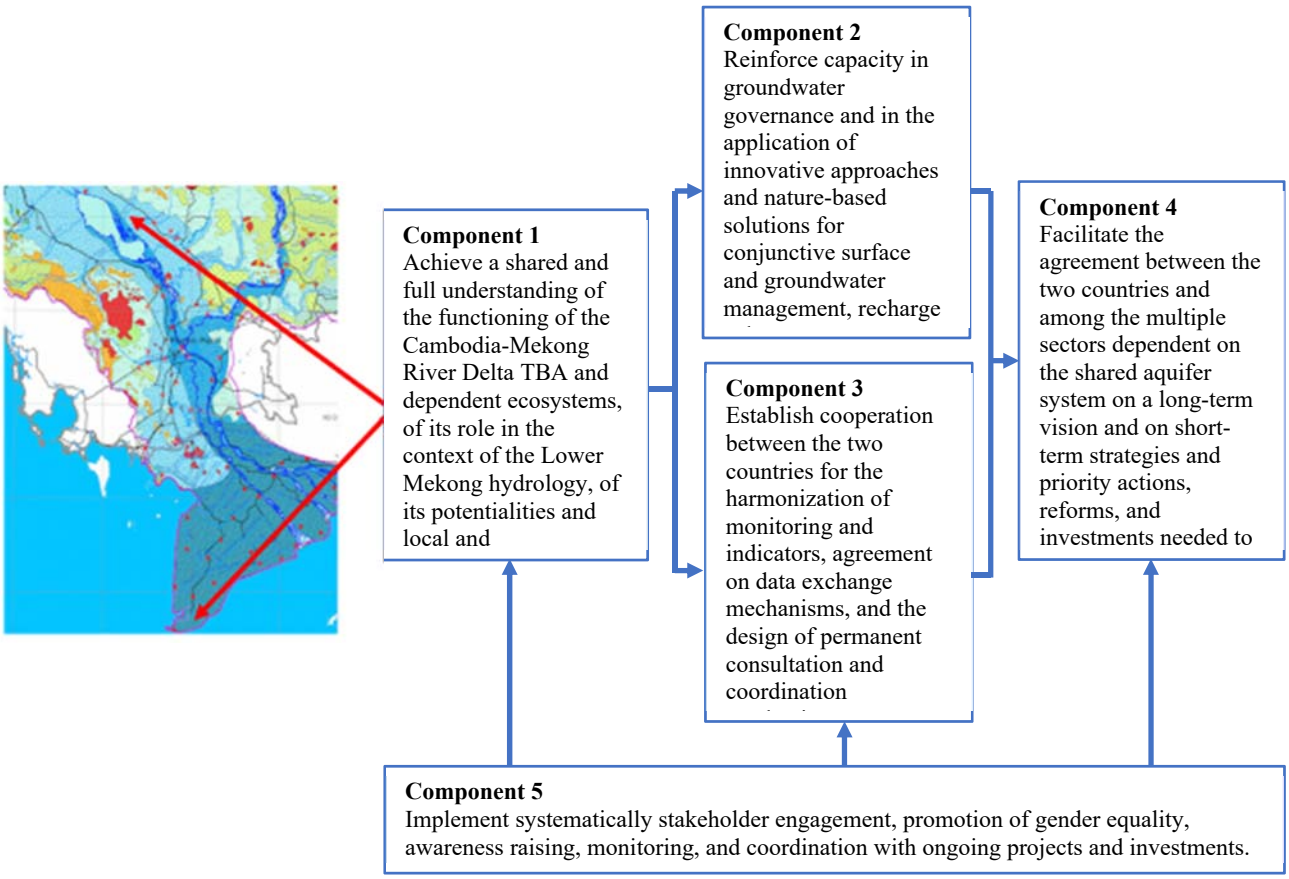


FIGURE 18: INTERVENTION LOGIC (CREATED BY AUTHORS)

Theory of change narrative

The **long-term goal** to which the project will work will be that the implementation of sustainable groundwater management, in line with the provisions of the binationally developed and agreed Strategic Action Programme (SAP), will lead to the sustainable and efficient use of groundwater, the preservation of ecosystems and their services, the mitigation of land subsidence, and adaptation to climate change across the CMDA region. The completion of the SAP by the end of the project will establish the foundation for the achievement of the **project objective**, which is to strengthen environmental sustainability and water security in the Lower Mekong Basin by investing, for the first time, in improved governance and sustainable utilization of the Cambodia-Mekong River Delta Transboundary Aquifer.

The project objective will be achieved through activities – outputs - outcomes structured into five interdependent causal pathways, which correspond to the five components of the project.

Actions under **Causal Pathway 1** (CP1) will focus on the realization of a joint science-based diagnostic of biophysical and socioeconomic conditions and problems in the CMDA area, leading to consensus among countries on key transboundary and national concerns affecting the aquifer. This consensus will be reached through joint fact-finding, which will open pathways to concerted remedial actions (e.g. recommendations for the design of demonstration projects and strategic actions). The principal output of this process will be a Transboundary Diagnostic Analysis (TDA) document (Output 1.3) together with agreed environmental status indicators (Outcome 1.4).

Actions under **Causal Pathway 2** (CP2) will complement those under CP1, focusing on piloting solutions for improved transboundary groundwater management, in order to fill gaps in knowledge and experience in the region. These demonstration pilots will introduce nature-based and technological solutions that are new to the CMDA area.

Actions under **Causal Pathways 3 (CP3) and 4** (CP4) will result in the formulation of bilateral cooperation mechanisms and planning instruments (in particular, the Transboundary Consultation and Coordination Body or TCCB and the Strategic Action Programme or SAP, respectively) which are the key elements on which the achievement of the objective ultimately depends.

The ToC features key linkages (indicated in the ToC diagram) among the sets of Causal Pathways:

I. The results generated through CP1 and CP2 (the TDA and demonstration projects) will feed inputs of information, models and experiences into the processes of negotiated binational planning and coordination foreseen under CP3 and CP4.
II. Causal Pathway 5 will support the overall process (CP1-4) through actions focused on ensuring the existence of the required conditions of institutional capacities, effective stakeholder participation, gender mainstreaming and monitoring and coordination.

These causal pathways would operate in parallel, with the following sequence:

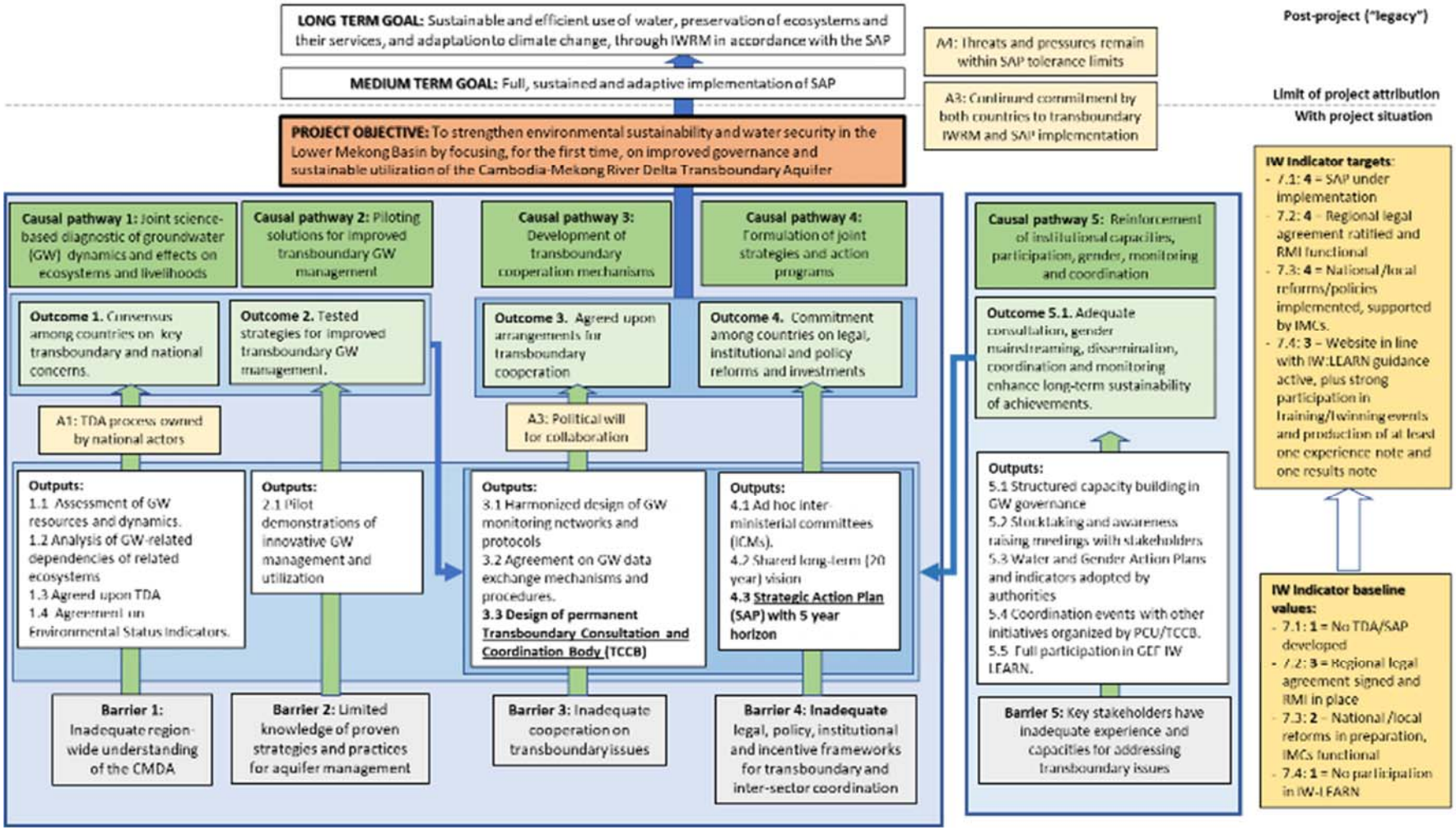
- During the first 15 months, the SAP process will focus on creating groups critical for transboundary dialogue and subsequent planning, and the development of a holistic vision for the management of the CMDA;
- By the end of that same initial 15-month period, it is foreseen that the TDA will be available as a draft.
- The presentation of the draft TDA and its resulting recommendations will then permit the confirmation of the demonstration projects, as well as providing the basis for the in-depth discussions leading to the formulation of the SAP.
- Once established, the demonstration projects will be managed in parallel to the process of formulation of the SAP, with their results serving to progressively inform the SAP process.

The functioning of these causal pathways in leading to the eventual achievement of the long-term goal of the project is dependent on a number of assumptions (shown in the ToC diagram):

- **A1:** the achievement of consensus, as expressed in the TDA, on the nature of the problems to be addressed through binationally coordinated management (Outcome 1) is dependent on **the TDA process being adequately "owned" by national actors**. To this end, the relevant institutions in both participating countries will be fully engaged in the definition of the terms of reference for the technical studies on which the TDA will be based, and the selection of the teams of specialist consultants responsible for carrying out the studies; fully consulted by the technical teams selected on the nature of the problems, including through inclusive technical workshops; and fully involved in the discussion and validation of the TDA findings.
- **A2:** the establishment and effective functioning of transboundary cooperation mechanisms will depend on the existence of **adequate and durable levels of political will for binational collaboration**. The measures proposed to maximize national ownership of the TDA will help to ensure that this assumption is realized, as it will help to ensure awareness among actors in both countries of the benefits achievable through collaboration. The project will also emphasize effective knowledge management, so that such information is continually available, in accessible formats, to stakeholders throughout the process of negotiating the establishment of the TCCB.

- **A3:** the achievement of the medium-term goal of full, sustained and effective implementation of the SAP will depend on there being **continued commitment by both countries to transboundary groundwater governance**. This commitment will be fomented by ensuring, during the project lifetime, maximum engagement of national actors in the processes of developing the TDA and the SAP, including sufficient representation of women, youth and ethnic minorities at all instances of stakeholders' involvement (Annex N2); by focusing on ensuring the durability of knowledge products generated through the project; and by promoting the inclusion in the SAP of concrete provisions and roadmaps for the formulation of supportive policy and regulatory instruments, that will outlast the project and commit stakeholders to implementing binational IWRM.
- **A4:** the long-term goal of achieving sustainable management of groundwater and dependent ecosystems, through the implementation of the provisions of the SAP, will depend on **the threats and pressures affecting the CMDA remaining within the tolerance limits of the measures proposed in the SAP**. To this end, the TDA will adopt a long-term vision in considering alternative future scenarios, including the potential implications of "worst-case" scenarios of climatic, economic and demographic change: the selection of the scenario to which the SAP will be designed to cope will be the role of the participating national stakeholders, based on considerations of levels of acceptable risk. The SAP will furthermore be designed as a "living document", allowing its provisions to be reviewed and adjusted in the future in response to changing circumstances.

FIGURE 19: THEORY OF CHANGE (CREATED BY AUTHORS)



Outcomes and Outputs

COMPONENT 1: JOINT SCIENCE-BASED DIAGNOSTIC FOR GROUNDWATER DYNAMICS (RECHARGE AND EXTRACTION) AND EFFECTS ON ECOSYSTEMS (E.G. FISH, WETLANDS) AND LIVELIHOODS

Outcome 1: Consensus among countries on key transboundary and national concerns affecting the aquifer, reached through joint fact finding, opening pathways to concerted remedial actions.

Outcome Indicator: TDA and the Environmental Status Indicators (ESI) endorsed by the country representatives in the Steering Committee.

The Outcome expected to be achieved by this Component is consensus among countries on key transboundary and national concerns affecting the aquifer, reached through joint fact finding, as prerequisite for the development and implemention of concerted remedial actions aiming at improving water security in the Lower Mekong Basin. By month 15 of the project life span, the assessment of the aquifer's water resources current state and projected scenarios, as well as of the evaluation of dependent ecosystems, will have been finalized; and month 18, the Transboundary Diagnostic Analysis (TDA), with corresponding Environmental Status Indicators, will have been submitted for endorsement to the Steering Committee.

The outcome will be obtained through four main outputs:

Output 1.1. Assessment of current state of groundwater resources, recharge and extraction dynamics

The jointly conducted assessment of the aquifer and its groundwater resources including (i) mapping of recharge and discharge areas, (ii) current water-table levels and of groundwater quality, exploitation and recharge dynamics, and (iii) the identification of trends for main drivers for groundwater exploitation and recharge (e.g. land use change, wetland management, agricultural water use). This will be complemented by (iv) a joint transboundary assessment of the socio-economic state related to groundwater resources. Furthermore, a detailed (v) assessment of groundwater governance will be conducted considering underpinning drivers for trends in groundwater extraction, groundwater recharge, surface water use, land use change, and groundwater quality changes.
This assessment will be implemented largely by national teams, supported by international experts, and in close collaboration with provincial and central planning agencies to ensure up-to-date data. UNESCO and its International Groundwater Resources Assessment Centre (IGRAC) have developed guidelines for multidisciplinary assessments of transboundary aquifers, a useful reference for this project (www.un-igrac.org/areas-expertise/transboundary-groundwaters). Experiences acquired from the implementation of multiple GEF IW projects will be brought into these component activities and shared with the National Teams, including the information contained in the Global Groundwater Information System (GGIS) and UNESCO's international knowledge network.
Selected by their Government local experts will be trained in among other topics modelling using an available state-of-the-art groundwater model. The exisiting model will be extended and updated with new information collected by the project to perform advanced system dynamics analyses and scenarios computations on groundwater flow and recharge, land subsidence and salinization. This process will also involve a data gap analysis to identify investment requirements to inform critical gaps for further improving evidence planning and decision making. Training activities and modelling will be carried out in collaboration with University of Padova, Italy (Pietro Teatini) and Wageningen University, The Netherlands (Philip Minderhoud). Pietro Teatini and Philip Minderhoud are members of UNESCO-LasII (Land Subsidence International Initiative).

Output 1.2. Analysis of groundwater related dependencies of related ecosystems

The jointly conducted analysis of groundwater dependent ecosystems (GDE) will include (vi) the evaluation of ecosystems state (e.g. wetlands) and ecosystem services (groundwater recharge, flood retention, nutrient reduction) at selected sites; and (vii) the assessment of the impacts of projected trends (including hydrometeorological trends and climate trends using downscaled climate information) and development scenarios on groundwater resources, ecosystems (e.g. wetlands), land subsidence, and livelihoods.

Similarly to Output 1.1, the general approach will be based on desk studies in coordination between national consultants / institutions and the international/regional consultant with possible support of research centers and compilation of data and information in a joint database when possible and relevant.

The results will identify which ecosystems are facing the highest risk and which ecosystem services are likely to experience further decline. The analysis will take a whole-of-system perspective to identify cause-effect relationships that connect drivers (e.g. groundwater extraction) with aquifer related outcomes (e.g. declining groundwater and lowering of land elevation in certain areas) with specific ecosystems (e.g. wetland) with ecosystem service (e.g. fish habitat and fisheries productivity). Revealing important dynamics in the complex social-ecological system is paramount for laying grounds for the identification of actions. This process will also involve the identification of possible intervention points for safeguarding groundwater dependent ecosystems (e.g. wetlands and subsequently fish), which will be focused on interventions most pertinent for mitigating adverse transboundary dynamics.

Output 1.3. Agreed upon Transboundary Diagnostic Analysis (TDA), including assessment of related governance, socio-economic, legal and gender aspects

A Transboundary Diagnostic Analysis (TDA) of the aquifer, based upon the above jointly conducted science-based assessments of the current state of groundwater resources and related ecosystems in the two national segments of the aquifer, considering also governance, socio-economic, legal and gender aspects. This will also include, but not be limited to: (viii) the review of existing legislative and policy frameworks related to groundwater and freshwater ecosystems; (ix) an analysis of socio-economic considerations, with focus on poverty, ethnic minorities, and gender inequalities; (x) the evaluation of existing and potential conflicts at the water nexus. The TDA process will facilitate an evidence-based discussion between Cambodia and Viet Nam that involves the identification and prioritization of transboundary problems to lay the foundation for the SAP process to specify strategic actions for joint implementation. The prioritization will be guided by indicators both countries will agree on and consider evidence for cause-effect relationships between bio-physical and socio-economic outcomes. To include socio-economic and gender aspects in the TDA, a gender analysis of ecosystem services, with particular emphasis on access, control over and use of groundwater resources will be conducted to inform gender-responsive transboundary groundwater management, and establish corporation mechanism. Detailed descriptions of gender analysis activities are described in Annex N2.

The TDA will consolidate the agreement between the two countries on the main issues of transboundary concern requiring joint remedial actions, and on those under national responsibility only. The diagnostic will include the description of the immediate and root causes of the degradation of the aquifer and of its related ecosystems.

Output 1.4. Agreement reached on Environmental Status Indicators

With support from the project, a limited number of simple and feasible Environmental Status Indicators will be agreed upon by the two countries to describe the state of the aquifer (baseline), to be applied periodically to monitor long-term trends, and the impacts of remedial measures.
All assessments will be done by national teams and supported by international experts. The two national teams will be coordinated by a regional TDA coordinator, who will be responsible for Component 1.

COMPONENT 2: PILOTING SOLUTIONS FOR IMPROVED TRANSBOUNDARY GROUNDWATER MANAGEMENT.

Outcome 2. Tested strategies for improved groundwater recharge, reduced extraction and mitigated ecosystem/ livelihoods trade-offs

Outcome Indicator: Demonstration project designs, implementation reports, and upscaling-focused assessments for three demonstration projects for improved groundwater management (extraction and recharge) in each country

This key component aims gaining experience of the feasibility and effectiveness of groundwater related innovative solutions and practices. Solutions will focus on a range of entry points ranging from the loss of groundwater recharge areas, groundwater extraction (extraction technology, regulation and other incentives, monitoring), and impacts of groundwater table changes on ecosystems (wetlands, fisheries) and livelihoods.

Critical contextual learning will be facilitated by demonstration projects of innovative groundwater management and utilization practices and solutions (Output 2.1.). The project preparation phase facilitated these discussions but, largely because of COVID measures restricting field missions, did not allow for the finalization of the design or (site) selection of demonstration projects: the identification of demonstration projects including site selection will therefore be concluded during the first year of the project execution phase, in parallel to the TDA process.

The ultimate selection and design of demonstration projects and the specific location of implementation will be made based on TDA results, and is expected to commence about 12 months after project start. Finalization of the design of the demonstration projects will allow them to start promptly in the second year of the project. Demonstration projects will be limited in number (approx. 2-3 per country) and size according to budget availability and country needs. The identification and design of demonstration projects will also consider short and long-term changes related to climate change.

An initial list of ideas for demonstration projects was identified during the project preparation phase, but as explained above will be confirmed during the first year of the project in parallel to the TDA process. These initial proposals are as follows:

1. Testing proven technology that is largely new to the CMDA area for improving groundwater use efficiency for agriculture. Options include:

- **Alternate wetting and drying (AWD) instead of continuous flooded irrigation methods.** This demonstration project would review AWD as a water-saving technology for rice cultivation and identify most suitable areas. AWD reduces irrigation water consumption in rice fields without decreasing rice yield by applying irrigation water a few days after the disappearance of the

ponded water. However, demonstration sites need to be selected carefully as many rice paddies are also used to farm fish.

- **Artificial groundwater recharge** pumping, utilizing current infrastructure to introduce systematic Aquifer Storage Recovery and Reuse (ASR/MAR).
  This demonstration project would explore options and effectiveness of injection wells to increase aquifer recharge during the wet season.
- **IoT solutions for improved irrigation control**.
  The combination of modern sensor technologies, the Internet, and advanced irrigation equipment combined in an Internet of Things (IoT) approach allow a relatively precise control of agricultural irrigation and creating the opportunity for high efficiency of water use for agricultural demands. Such systems have been trialed elsewhere and provided farmers with improved irrigation control according to seasonal and daily irrigational needs while reducing irrigation water demands.
- **Drip and micro irrigation for upland crops.**
  Drip irrigation can provide very efficient irrigation for a variety of crops as it comes with the advantage of lower evaporation than other irrigation methods. Drip irrigation is one of the more advanced techniques being used today because, for certain crops, it is much more efficient than traditional spray, furrow or flood irrigation, where a larger portion of the water is lost to evaporation.

2. **Artificial wetlands** and the **improved management of existing wetlands** to reduce the infiltration of agricultural pollutants into groundwater.
   This demonstration project would identify locations for artificial wetlands to effectively improve aquifer recharge as a nature-based solution in locations where recharge requires most improvement. Similarly, wetland management of existing wetlands would be reviewed to identify potential improvements for increased groundwater recharge without compromising on other existing goals such as biodiversity and flood mitigation. The project preparation phase allowed for commencing this discussion based on the lists provided in Table 27 and Table 28.
3. Testing of the effectiveness of **artificial macro-pores** in soils with poor infiltration.
   Macro-pores have proven to be a very effective nature-based solution for a variety of issues ranging from improving degraded soils to increasing aquifer recharge. The demonstration project would identify suitable locations and test the effectiveness of different types of macro-pores (e.g. empty or fiber-filled macro-pores) and different techniques for creating artificial macro-pores.
4. Design and test community and **household incentive schemes** for reducing groundwater extraction and increase groundwater recharge (e.g. aforementioned nature-based solutions, incl. wetlands and macro-pores, but also new technologies for monitoring, artificial recharge, and uptake of water use efficiency enhancing irrigation and women-friendly, labor-saving technology, responding to women's and men's needs).
5. **Integrated land use planning** for selected key sections of the CMDA to incorporate groundwater recharge and spatial aquifer vulnerability in land use change decisions.
   A few ongoing planning processes at central and province government level will be selected and injected with groundwater-focused information to advise planners regarding direct and indirect impacts on groundwater and flow-on effects. The PPG process has identified

candidates for targeted planning processes, including the selection of areas for reforestation, establishment of wetlands, changes in wetland management, and changes in crop production systems.

COMPONENT 3: TRANSBOUNDARY COOPERATION MECHANISMS

Outcome 3. Agreed improvements of transboundary cooperation improve aquifer transboundary governance

Outcome Indicator: Agreement on the creation of a Bilateral coordination and consultation body (TCCB) signed by two countries.

This Component will focus on the design and establishment of arrangements for transboundary cooperation mechanisms between Viet Nam and Cambodia, aimed at improving transboundary governance of the aquifer (outcome). Firstly, the most relevant agencies in both countries at the various levels of governance (village, district, province, state) will be identified and their roles and responsibilities will be defined. In light of the lack of gender responsive governance arrangements over transboundary groundwater resources, it is key to take gender inequalities into consideration from an early stage on, as an important component of groundwater governance. This will be done through a tailored Gender Integration and Equality Approach for Transboundary Aquifers described in Annex N2. By project mid-term, the design and TORs of new cooperation mechanisms will have been prepared by the Joint Technical Committee, and by project end a shared vision and design of new permanent cooperation frameworks and mechanisms will have been submitted for clearance to the Steering Committee.

Outputs of Component 3 will consist of:

Output 3.1: Harmonized design of groundwater monitoring networks and protocols.

The most important item in this phase, is that the countries agree about a purpose of the monitoring (i.e. which groundwater-related issues are relevant) and about data/info required to be shared. An essential tool for groundwater management, the networks will be harmonized across the two country segments of the aquifer in terms of positioning, analytical methodologies, instrumentation, data transmission, collection and custodian protocols. The networks will be multi-purpose and monitor groundwater extraction rates and quality, meteorological data and meteorological data, aquifer recharge, and wetland condition.

Initially, existing groundwater monitoring networks and their effectiveness will be assessed. This will involve field missions and interviews with practitioners. Existing monitoring systems will be compared with state-of-the-art solutions and existing gaps and potential for improvements will be specified. One of the solutions to be proposed to CMDA stakeholders will be the recently developed UNESCO's IGRAC framework for a regional groundwater data collection and management that includes a groundwater monitoring (https://www.un-igrac.org/resource/sadc-framework-groundwater-data-collection-and-management), which can facilitate an agreement on data exchange mechanisms and procedures, responsible institutions, frequency and means of communication, maintenance and support of common information portal, etc.

The model will be used to identify the most critical data gaps, in space and type, and provide a scientific basis to optimize monitoring network planning for piezometric level, and land subsidence. This process will involve at least one workshop to showcase the design and implementation of monitoring networks in regions with comparable aquifers. Upon definition of needs and design for a harmonized monitoring system, high-priority monitoring equipment will be purchased and applied and the relevant capacity building for practitioners and decision makers will be conducted.

Output 3.2: Agreement on groundwater data exchange mechanisms and procedures.

Lack of modern groundwater monitoring networks has been identified during the project preparation phase as a major obstacle to sustainable groundwater management. The project will hence engage in the design of a modern *multi-purpose* (surface and) groundwater monitoring networks taking into consideration the results of Component 1, the socio-economic conditions of the countries and network sustainability issues. The purposes of the network will be to provide information on:

- Groundwater level changes
- Groundwater recharge dynamics
- Groundwater quality
- Groundwater salinity
- Land subsidence following aquifer exploitation
- Wetland condition and subsequent impacts on fisheries
- Interactions of surface and groundwater;

The networks should ensure a homogeneous, albeit sparse, coverage of the CMDA segments in each country. It will include both quantity and quality (salinity) detection systems. Stations will include data loggers, and real time transmission of data (very remote areas, etc.).

The feasibility and sustainability of such networks will be pilot tested in each country, and a very limited number of stations will be acquired and installed based on the equipment purchased for the related work of Output 3.1. Optimization of station location and depth will take advantage of the dynamic modelling analyses. The networks design - including monitoring protocols, real-time data exchange mechanisms – will be developed by JTCs in consultation with provincial and local administrations and communities. Approval of a formal data sharing protocol (such as an MoU) and so far, information management systems will be responsibility of the SC. An official written request will be made to the benefiting countries asking them to overtake the ownership of the equipment, their operation and maintenance and to integrate them to the national network.

Output 3.3: Design of a transboundary consultation and coordination board (TCCB).

Under this activity, the project will design and establish a transboundary consultation and coordination board (TCCB) for the CMDA area. The TCCB will cover the entire CMDA area and operate through periodic meetings and be formed by officials of the relevant ministries and governmental agencies. facilitate the establishment of a permanent mechanism for: (i) ensure systematic bilateral consultations on common issues related to the sustainable management of the aquifer, (ii) conflicts resolution, (iii) coordination of ongoing and planned TA and investment projects impacting on groundwater resources and related ecosystems. In a participatory process, both countries will co-design roles and responsibilities of the TCCB and its members, based on agreed upon TORs and be supported by a Secretariat. The countries will also nominate TCCB members. Special efforts will be made to ensure sufficient representation of women, youth and ethnic minorities within the TCCB as described Annex N2. The TCCB will meet at least twice per year.

<u>COMPONENT 4:</u> JOINT STRATEGIES AND ACTION PROGRAMS

Outcome 4: Commitment reached among countries on implementing priority legal, institutional and policy reforms and investments for the protection and equitable utilization of the shared aquifer and its dependent ecosystems

Outcome Indicator: SAP approved/signed by the relevant Minister(s) in each country.

Component 4 will aim at obtaining the political commitment of the countries to implement the priority legal, institutional and policy reforms and investments necessary for the protection and equitable utilization of the shared aquifer and its dependent ecosystems (outcome). This will be done through three sequential steps (outputs):

Output 4.1: Countries establish Joint Technical Committees (JTCs) and ad hoc inter-ministerial committees (IMCs)

The JTCs will involve national experts and decision makers from both countries and will be established for each of the core topics, e.g. groundwater recharge (incl. wetlands), and groundwater extraction (incl. irrigation). The JTCs will be critical for section indicators (Output 1.4), developing a shared vision (Output 4.2), and for discussing the TDA results to draft and finalise the Strategic Action Programme (SAP) (Output 4.3).
The IMC committees will facilitate policy coordination with relevant sectors especially at national level, in particular with policies for surface water management, land-use planning, agriculture, and energy. The most critical role will be to present cross-sector impacts from the TDA and contribute to the design and implementation of solutions that require improved cross-sector coordination or the mitigation of cross-sector trade-offs. Consequently, IMCs will be a critical element of the SAP process, particularly for the implementation of the bilaterally agreed action plan for improved transboundary groundwater management in national action plans, which will require sector specific actions. During the PPG phase a list of key province and central Government agencies to be involved in the IMC was identified. This is shown in the stakeholder engagement plan and will be further developed during the first months of the project implementation phase. The inception meeting will be held during the first quarter of the project.

Output 4.2: A shared long-term Vision (horizon 20 years) including the agreement on environmental quality targets

The shared long-term Vision, based on the results of the previous Components, will be elaborated by the TCCB with the support of project experts, and will be translated into mutually agreed concrete long-term environmental quality targets (e.g. groundwater level, land subsidence rate, groundwater recharge target, groundwater extraction quota). The visioning process will build on evidence in form of an assessment of main drivers and trends for a set of priority policy indicators. The shared holistic vision will be compiled during two workshops and will distinguish between most desirable, most likely, and least desirable futures. During the workshop participants will debate options for required interventions to avoid least desirable futures (risk management strategy) and actions that shift the most likely to the most desirable future.

Output 4.3: Strategic Action Program (SAP) with horizon of 5 years, consistent with the Shared Vision.

A Strategic Action Program (SAP) with horizon of 5 years, consistent with the Shared Vision and the recommendations of the TDA, will be prepared with broad participation of stakeholders and of the IMCs. The TDA will provide from a whole-of-systems perspective the causal understanding for intervention points while the shared vision will provide the desirable future as jointly defined by both countries. These two inputs (TDA and shared vision) will provide the necessary inputs for both countries to debate key actions (policy, legal and institutional reforms, investments) that will be deemed necessary to reverse the degradation trends of the transboundary aquifer and its related

ecosystems, and improve overall sustainability in the Lower Mekong basin and delta. These strategic actions will reduce groundwater extraction and/or increase groundwater recharge in the areas most critical for unsustainable transboundary developments. Strategic actions will be formulated as specific investment needs with clearly articulated underpinning assumptions and a rational for what biophysical and socioeconomic benefits are expected from these investments. This process will be completed in a series of at least three workshops that build on the visioning workshops and on the TDA results. The Water and Gender Action Plans developed as part of this project (see Output 5.3 and Annex N2) will inform and contribute to the preparation of the SAP. The SAP will be submitted for countries' endorsement and is to be endorsed by a Minister from each country. The SAP will also be presented to the international donor community and other stakeholders to trigger if possible immediate funding of proposed actions or supporting initiatives.

COMPONENT 5: REINFORCED INSTITUTIONAL CAPACITY, IMPROVED PARTICIPATION, GENDER MAINSTREAMING, MONITORING AND COORDINATION

Outcome 5: Implementation of project mechanisms for monitoring, improved stakeholder consultation, gender mainstreaming, dissemination, coordination and monitoring progress enhance long-term sustainability of achievements.

Outome Indicator: Skills and knowledge on transboundary issues of 100 gender-balanced national staff increased by 50 percent over baseline levels.

The Component will put in place mechanisms for systematic stakeholder's participation, gender mainstreaming, dissemination, coordination and monitoring progress with the aim of supporting the overall process for enhancing long-term sustainability of project achievements (outcome). For doing so, four main outputs/processes will be produced:

Output 5.1: Structured capacity enhancement in groundwater governance for decision makers and other stakeholders

The project will support structured capacity building in groundwater governance for decision makers and other stakeholders at national and regional (Cambodia-Viet Nam) levels, designed closely following the guiding principles and recommendations of the Groundwater Governance GEF/FAO project. Of particular relevance are (1) the overall assessment framework, which will guide the TDA, (2) the opportunities for addressing the gaps in groundwater governance (e.g. modern technologies for data acquisition, legal instruments for transboundary, aquifers, coherent groundwater management planning, involvement of the private sector), and (3) following recommended principles (equitable access, sustainability, transparency, participation, accountability, functional integration, precautionary principle, knowledge management).. It will also include study visits to international exemplary cases of successful transboundary aquifer management efforts (e.g.: Guarani Aquifer, shared by Argentina, Brazil, Paraguay and Uruguay). During the first six months, of the project a capacity gap analysis will be conducted together with key project stakeholders. Based on the gaps, a systemic capacity enhancement program will be developed, which will be annually revisited and revised as needed to adapt to the evolving project outputs (e.g. TDA recommendations, demonstration project design). The project will enable training of Vietnamese and Cambodian experts, in order to manage the scientific tools developed within the project and support decision makers and other stakeholders, also after the project conclusion. Complementary to these assessments, a diagnostic study of gender responsiveness of water policy frameworks in both countries, and a gender and

ethnicity knowledge needs assessment will be carried out and included in the comprehensive capacity needs assessment report (Annex N2).

Output 5.2: Annual stocktaking and awareness raising meetings with relevant stakeholders (e.g. local, national and regional meetings)

Annual stocktaking and awareness raising meetings will be carried out with the participation of all relevant stakeholders, including the private sector, held at local, national and regional levels. Special efforts will be made to ensure sufficient representation of women, youth and ethnic minorities at all instances of stakeholders' involvement. The annual stocktaking will elaborate on activities implemented during the course of the project to raise the profile of the project and its various components as well as to improve the communication flow between the project team and other stakeholders. The meetings will be held in the CMDA area and will be hosted by the PMU and the TCCB, including the lead agencies of both countries.

Output 5.3: Water and Gender Action Plans including gender indicators and budget for sustainable water groundmanagement, based on results of Component 1, adopted by relevant authorities in both countries

Water and Gender Action Plans for sustainable groundwater management and specific gender-sensitive indicators will be prepared, based on results of the gender analysis undertaken within the TDA under Component 1, for adoption by relevant authorities in both countries. Findings and insights collected with the the adoption of the Gender Integration and Equality Approach for Transboundary Aquifers by the project (Annex N2) will inform the development of the Water and Gender Action Plans (GAP). This activity will involve the specification of gender-sensitive indicators and related budgets to address gender inequalities identified for groundwater use, related livelihoods, and groundwater dependent ecosystems and ecosystem services key for rural livelihoods as well as the design of draft affirmative actions to overcome gender inequalities over a specified time frame with selected monitoring mechanisms.

Output 5.4: Periodic events for the coordination with other ongoing initiatives organized by the PMU/TCCB

Periodic events will be held for the coordination with other ongoing initiatives organized by the PMU/TCCB. The events will improve the coordination with other projects by providing succinct presentations of the project's progress, and findings. This will involve the provision of assessment reports or data to baseline projects. The workshop will include discussions to identify additional potential for cross-project synergies and processes to realize these synergies.

Output 5.5: Full participation to GEF IW LEARN activities, creation of a project website, and preparation of experience notes.

The full participation in GEF IW LEARN will ensure that CMDA project activities can benefit from lessons learnt elsewhere as well as providing insights form the CMDA context for projects in other parts of the world. All results in form of assessment reports and summary of workshops and other events will be provided on the project webpage together with mechanisms to allow for immediate cross-project exchange (e.g. online forum).

4) Alignment with GEF focal area and/or Impact Program strategies;

The project is fully consistent with GEF-7 programming directions, in particular with objective 3 of International Waters Focal Area: Enhancing water security in freshwater ecosystems and its three strategic actions:

- **Advance information exchange and early warning**. The project will support the following kinds of investments highlighted under GEF-7 guidance: nature-based solutions (under Component 2); enhanced quality, coverage and free availability of sound information on surface and groundwater availability and use and natural resources (under Component 1); increased capacity to gather, distill and process global and regionally increasingly available traditional and innovative data sources into policy relevant analysis, including the economic evaluations of ecosystem services (under Component 1); enhanced capacity on country level and dialogue among countries to draw conclusions from increasingly complex and innovative information sources to support decision making and to identify joint opportunities for action (under Component 1);
- Enhance regional and national cooperation on shared freshwater surface and groundwater basins. The project will support the following kinds of investments: common, participatory fact-finding and agreement on cooperative opportunities and shared constraints and a vision for a shared future (via the TDA and SAP under Components 1 and 3); identify and leverage resources for investments addressing SAP identified priorities (under Component 3); engagement with national, regional and global stakeholders to increase collaboration and cross support to investments and processes, through IW-LEARN (under Component 4).
- Investments in water, food, energy and environmental security. A number of the kinds of investments highlighted in GEF-7 IW guidance will be included in the pilots proposed under Component 2, subject to confirmation by national stakeholders.

The project implementation process will follow GEF's TDA-SAP guidelines and will be aligned with IW guideline documents.

5) Incremental/additional cost reasoning and expected contributions from the baseline, the GEFTF, LDCF, SCCF, and co-financing;

The current baseline conditions for groundwater resources management, in the Cambodia-Mekong Delta Aquifer region, fundamentally consist of either:

- Individual national economic development programs, which are the responsibilities of various levels of government and primarily focus on individual country needs.
- Other environmental management activities including ongoing environmental monitoring programs, informational programs, and related activities at the national and local levels.
- Fragmented monitoring efforts at the national levels.

Current planning processes are driven by sector interests within each country, which causes highly unsustainable developments for the shared aquifer (the impacts of which are not well understood or quantified). Sustainability advancements depend on effective transboundary management strategies. The regional increment (e.g. transboundary aquifer management plan) will lead to much larger benefits than isolated national development strategies as actions can be coordinated based on a shared and jointly accepted evidence base. The present project seeks to overcome the barriers hindering regional coordination in the management of the aquifer - such as lack of knowledge of the aquifer

characteristics and functioning, and of coordination management tools, frameworks and capacity - by developing a number of incremental regional actions focusing on building a shared science based knowledge of the aquifer, on the facilitation of regional technical cooperation frameworks and monitoring capacity, fostering stakeholders' participation, women empowerment, thus advancing coordination among the aquifer's countries and their ability to enhance synergies among the many ongoing fragmented sectoral actions (baseline contributions).

TABLE 13. ***SUMMARY OF INCREMENTAL LOGIC***

Barriers	Selected baseline investments	Gaps in the baseline	Project components and incremental value added
1: Lack of a shared, adequate understanding across the region of biophysical and socioeconomic conditions and processes associated with the CMDA	***Research, monitoring and knowledge management:*** - Groundwater mapping and monitoring (e.g. MRC; ADB, World Bank, UNICEF and CNMC in Cambodia; MONRE/MARD in Viet Nam) - Research cooperation e.g. MRC, LMC, GMS - Land subsidence monitoring (e.g. Rise and Fall in Viet Nam)	Investments in research, monitoring and knowledge management are largely country- and issue specific and not channeled effectively to policy -makers in such a way as to allow the development of a shared vision.	**1: Joint science-based diagnostic for groundwater dynamics (recharge and extraction) and effects on ecosystems (e.g. fish, wetlands) and livelihoods)** ➔ Shared, harmonized and integrated understanding of CMDA issues of transboundary significance
2: Limited knowledge across the region of proven strategies and practices for aquifer management and recharge	***Water/wetland management:*** - Wetland conservation (e.g. MoE, KFW, LMC, WB in Cambodia) - Irrigation and water management (e.g. JICA, ADB; MARD and FOLUR in Viet Nam) Climate resilience measures: - e.g. WB/ICRSL in Viet Nam Mekong Delta	Knowledge resulting from investments in technical approaches to CMDA management is not effectively generated, shared or applied, with a vision of shared/trans-boundary problems.	**2: Piloting solutions for improved transboundary groundwater management** ➔ ***Enhanced availability of knowledge*** on options for addressing ground-water related issues of transboundary significance in an integrated manner
3: Inadequate cooperation on transboundary issues	***Cooperation*** in research, sharing information on water resources and sustainable development of water resources (MRC, LMC, GMS)	Existing cooperation mechanisms do not specifically or adequately address CMDA issues	**3: Transboundary cooperation mechanisms** ➔ Conditions for effective and institutionally-sustainable coordination on transboundary issues
4: Legal, policy, institutional and incentive frameworks	***Strong nationally-specific legislative and policy frameworks*** ***Resource planning:***	Frameworks have limited focus on country- and sector-specific issues	**4: Joint strategies and action programs**

Barriers	Selected baseline investments	Gaps in the baseline	Project components and incremental value added
do not specifically facilitate transboundary and inter-sector coordination	- Mekong Delta Master Plan (Viet Nam) - IUCN Integrated Planning Project Viet Nam - Australian Aid funded Mekong Delta Futures project ***Resource governance*** - Enhancing Local Water Government in Mekong delta (UNDP –VNWP)		- Negotiated, evidence-based and actionable road map for putting collaborative action into practice
5: Key stakeholders have inadequately developed experience and capacities for addressing transboundary issues sustainably	National institutional structures (e.g. Ministries of Environment and Agriculture)	Limited institutional focus on national and sector-specific issues	**5: Reinforced institutional capacity, improved participation, gender mainstreaming, monitoring and coordination.** - Durable capacities for participatory, gender-sensitive, adaptive and collaborative approaches to CMDA management

6) Global environmental benefits (GEFTF) and/or adaptation benefits (LDCF/SCCF);

In the area of water resources management, this project will promote a coordinated and integrated approach to prevent environmental degradation from overexploitation of groundwater resources. Many risks cannot be mitigated by one country alone as the complex aquifer system connects both countries. Consequently, transboundary solutions become paramount for addressing land subsidence and salinity intrusion, as well as the rapid decline of groundwater and the widening threat of arsenic and other pollutants. Successful transboundary groundwater management in the CMDA area will improve the resilience of globally important ecosystems, including the Tonle Sap and the Mekong Delta and a list of significant (partly RAMSAR-listed) wetlands.

The Transboundary Consultation and Coordination Body (TCCB) will promote jointly agreed allocations among competing uses, equitable distribution of benefits and burdens, adequate involvement of both women and men and community participation in addressing sustainability in water resources management. The project will additionally promote gender equality in the areas of management, governance, and policy development (Annex N2). The project will emphasize cross-sectoral, inter-ministerial, integrated ecosystem and landscape scale approaches that rely on consultative processes and provide a basis for setting up regional conjunctive surface and groundwater management agreements and processes. Ultimately, GEB outcomes include

- Improved resilience of groundwater dependent ecosystems (e.g. wetlands, fish abundance and diversity – including globally important wetland ecosystems and species, and long-range migratory fish);
- Improved water security of around four million households depending directly or indirectly on groundwater;
- Increased sustainability of globally-important food production systems (e.g. irrigated rice, aquaculture), associated with the sustainably improved conditions of the transboundary water resources on which they depend).

7) Innovativeness, sustainability, potential for scaling up and capacity development.

Innovation

The project capitalizes on and extends a state-of-the-art hydrogeological model, capable of modelling groudwater flow, and land subsidence from the Vietnam portion of the delta to the entire CMDA area. The model will allow understanding how anthopogenic activities (groundwater pumping, managed aquifer recharge, etc) and climate change scenarios (e.g., change of rainfall distribution in time and space) will affect (i) the piezometric head distribution in space, depth, and time; (ii) the expected land subsidence; and (iii) the consequences on target ecosystems (Output 1,1 and Output 1.2). State-of-the-art implementation will allow quantifying uncertainties in the modelling outcome and possibly reducing them by assimilating records provided by the data collected duirng the project and the optimize monitoring networks (Output 3.1).

The project addresses, amongst others, a challenge faced by many large transboundary aquifers globally, as demonstrated by the findings of the TWAP project (http://geftwap.org/twap-project): how to implement an aquifer wide harmonized monitoring system covering both short-term and long-term trends in the quality and the quantity of the groundwater resources. It does so by fostering the design and applying an innovative multi-purpose groundwater monitoring network (Output 3.1) based on the best science available, and the definition of sampling/monitoring protocols harmonized across the two project countries. Realizing such a science-based transboundary aquifer cooperation mechanism is innovative considering that only a handful of these exist worldwide. Furthermore, the

comprehensive scientific understanding of groundwater dependent systems (e.g. food production, wetlands, and fish production) is still innovative for southeast Asia and also globally. Also, the demonstration project will introduce nature-based solutions and technologies that haven not been trialed before in the CMDA area.

Sustainability

The project will build multi-country cooperation frameworks, as well as institutional capacity and expertise in groundwater governance. The institutional and financial sustainability of the project outcomes will be ensured through commitment of the two countries to implement the strategic and priority actions enshrined in the SAP. The project will ensure country commitments by providing robust evidence through the TDA that specifies the benefits each country will gain when improving transboundary groundwater management. This will reach from obtaining improved data for the support of planning processes to jointly agreed investment programs that improve water and food security on both sides of the border. This evidence-based approach will create already during the lifetime of the project positive experiences that will showcase these benefits. The creation of the TCCB and the IMCs will create a new institutional foundation for transboundary groundwater management and establish the relevant links between government agencies in both countries. While the project cannot guarantee that the TCCB or the IMCs will be maintained after the project ended, the project will establish the benefits both countries gain from continuing and even deepen the transboundary groundwater management framework.

Potential for Scaling Up

Component 2 of the project is dedicated to the testing on the ground of nature-based solutions and practices aimed at reversing water table lowering trends, and groundwater contamination. The dissemination of the results of these experiences and of the progress towards achieving the desired impacts, will foster the scaling up and broader adoption of the successful practices promoted by the project to the level of the whole aquifer, and beyond, to other regions and major transboundary aquifers globally.

While demonstration projects will not be fully designed before the TDA results are available, which aims to ensure a contextual focus and prioritization, demonstration projects are likely to include innovative groundwater monitoring (e.g. automated, real-time monitoring sensor systems) or artificial aquifer recharge technologies, incentive mechanisms for improved groundwater use, and/or advanced transboundary groundwater governance mechanisms. These applications, while piloted in selected sites, they will have the potential to be replicated and scaled up, in the CMDA are and beyond. The lessons learnt will be able to inform during upscaling activities:

- Other countries experiencing rapid land subsidence due to groundwater over-extraction (e.g. Bangkok, Thailand; Jakarta, Indonesia)
- Coastal areas experiencing salinity intrusion (e.g. Benin; Pakistan),
- countries facing risks of losing groundwater dependent ecosystems such as wetlands (e.g. China; India),
- Countries suffering from high levels of arsenic and other contaminants (e.g. Nepal; Bangladesh; India), and
- Areas experiencing unsustainable groundwater use (e.g. India; China).

Capacity building

Component 5 of the project will conduct a broader capacity building program encompassing a wide array of topics relevant for transboundary groundwater management. The detailed curriculum for the 5-year program will be determined after a capacity gap analysis has been conducted in the first months of project implementation and prioritization of those by the key stakeholders involved.

To fully mainstream and integrate gender and ethnic minority considerations across the activities, the project will strengthen the capacity of relevant stakeholders to adopt gender-responsive approaches and effectively integrate gender and minorities into TBA governance, as well as the use of disaggregated water data (by gender, age, and ethnicity) and of gender-responsive indicators. Details of the capacity development approach are provided in Annex N2.

8) Summary of changes in alignment with the project design with the original PIF

ProDoc section	Change
Output 4.4: Countries establish Joint Technical Committees (JTCs) and ad hoc inter-ministerial committees.	We added "Joint Technical Committees (JTCs) and" to allow for an effective mechanism for transboundary coordination at the technical level. This was unintentionally omitted from the PIF.
Output 5.4: Periodic events for the coordination with other ongoing initiatives organized by the PMU/TCCB.	We changed PCU to PMU to have a consistent reference to the Project Management Unit (PMU) instead of a Project Coordination Unit (PMU).
Output 5.5: Full participation to GEF IW LEARN activities, creation of a project website, and preparation of experience notes	This was unintentionally omitted from the version of the PIF in the GEF portal but has been included in the ProDoc.
Table B Project Description	Final figures updated and M&E budget included
Table C Cofinancing	• USD 15 000 000 of the "Viet Nam Irrigation investments and economic restructuring" cofinancing has been reclassified as Investment Mobilized, without affecting the total. • The final co-financing value confirmed by the Cambodian Government has increased if compared to the PIF stage. • Partners' co-financing added • Overall co-financing increased to a ratio of 1:7.64

1.b Project Map and Geo-Coordinates.

Please describe the project sites and provide geo-referenced information and map where the project interventions will take place.

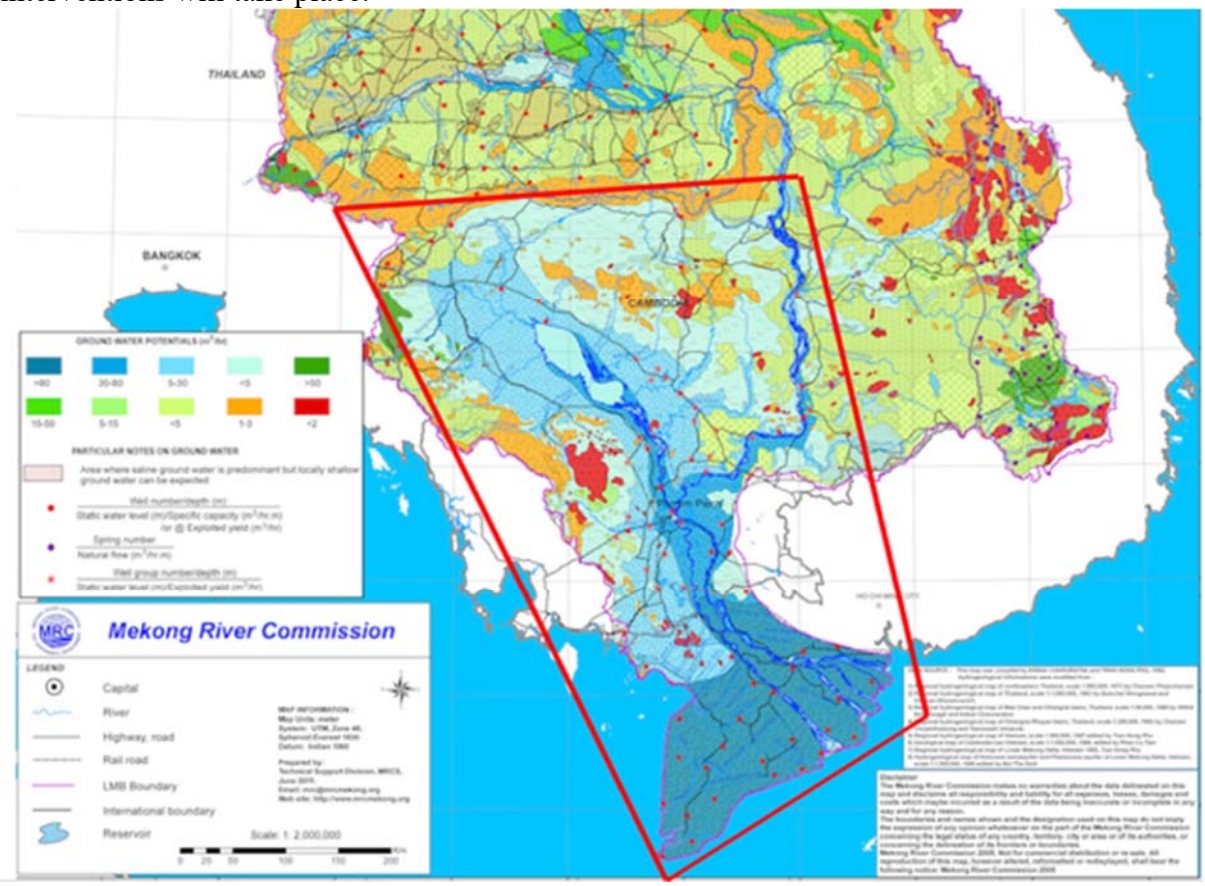


FIGURE 20: INDICATIVE MAP OF CAMBODIA-MEKONG DELTA AQUIFER (SEEBACHER, GROUNDWATER IN THE MEKONG REGION – TRANSBOUNDARY AQUIFERS, HCMC, VIETNAM, MEKONG RIVER COMMISSION SECRETARIAT, 2014. *HIGHLIGHT BY AUTHORS*)

2. Stakeholders.

Select what role civil society will play in the project:
☒ Consulted only;
☐ Member of Advisory Body; contractor;
☐ Co-financier;
☐ Member of project steering committee or equivalent decision-making body;
☐ Executor or co-executor;
☐ Other (Please explain)

Annex O provides details for the stakeholder engagement process during the PPG phase. During the execution phase, the project will engage with the following stakeholder groups:

- **Government:** Line ministries in the capital city, officials at the provincial and district level and community-based organization.

- **Development Partners:** Multilateral and bilateral development partners in the study area.
- **Civil Society Organizations:** International non-profit organizations, local non-profit associations, academia and research groups.
- **Private Sector:** Representatives from the business sector, small and medium enterprises.
- **Community Based Organization:** Village organization unit, and local people.

The engagement process will include both face-to-face meetings as well as online/web-based platform to enable participation by a wide range of stakeholders. The structure of face-to-face meetings will allow plenary presentations and discussions and, if needed, small group discussions, and reporting with a neutral facilitator. For online engagement an online survey will be available to people interested to participate who may not be invited.
Governments, private sector, and development partners will be engaged with in the required language with simultaneous translation if needed. The engagements of provincial, district officials, civil society organizations and other local groups will be conducted in Khmer language simultaneous translation if needed.

Cambodia

The inception workshops and site visits aimed to collect and analyze stakeholder interest, needs, expectations and concerns as well as to identify the possible field of participations, measurement, and approaches may be applied during project implementation in order to ensure the effectiveness of the project intervention. Table 14 summarizes stakeholder interests and concerns. Annex Q provides descriptions of stakeholder groups and their mandate.

TABLE 14: KEY STAKEHOLDERS AND THEIR ENGAGEMENT DURING THE IMPLEMENTATION PHASE IN CAMBODIA

No	Stakeholders	Stakeholder profiles	Interests and concerns	Engagement
National Level: Ministry of Environment				
1	General Department of Education and knowledge management (GDEKM)-MOE	GDEKM is mandated to manage environment-related data and information. GDEKM also supports the coordination and facilitation of promotion and education on environmental information in Cambodia. National GEF Focal point – Project Focal point	Need joint transboundary environmental management related to groundwater changes. Need establishment of a database for groundwater resources and promoting the efficient use of groundwater to improve the balance with wetland and habitat management, and conservation Concerns: Environmental pollution; Reduction of wetland, forest, biodiversity; Inconsistent legal framework.	Execution of parts of the project (e.g. demonstration projects). GDEKM can be engaged by: • Faciliate cross sector coordination. • Provide technical advice and guidance on for the SAP. • Support the development of transboundary cooperation mechanisms.
2	Department of Freshwater Wetland Conservation (DFWC)	DFWC is mandated to ensure the conservation of national freshwater wetlands in consevation zones under the Ministry of Environment. DFWC develops the national strategy for wetland conservation in Cambodia.	Interests: Groundwater dependent wetlands and how to create resilient wetlands. Concerns: rapid changes of freshwater wetland and losing of natural habitat due to rapid changes of surface water flow and decline of groundwater.	DFWC can provide technical assistance in implementing the follwing key actions: • Support the TDA. • Co-designing and executing demonstration projects. • Assist in SAP and NAP. • Data and information related to freshwater wetlands. DFWC will participate in national consultation meeting and implementation of pilot project and scientific study and policy and strategy formulation
3	National Council for Sustainable Development (NCSD)	NCSD is mandated for promoting the national sustainable development plan (e.g. climate change, biodiversity conservation, and green growth) and promoting the use of science and technology for environmental management and protection.	Interests: Improved groundwater management for better and sustainable biodiversity and improved efficiency for better environmental management. Concerns: Loss of freshwater wetlands and natural habitat due to rapid changes of surface water flow and groundwater decline. Impact of groundwater quality on biodiversity and people's health.	NCSD can provide support for the the SAP, help improve institutional capacity, and develop national policies and plans for substainable groundwater use. NCSD will participate in national consultation meeting and implementation of pilot project and scientific study and policy and strategy formulation
4	Department of Climate Change (DCC)	DCC is mandated to coordinate and facilitate climate change management, policy formulation and the national strategy on climate change management and mitigation.	Interests: The impact of climate change on groundwater resources and how to mitigate losses. Concerns: surface water flow and groundwater decline due to climate variation. Impact of climate change in groundwater quantity and quality.	DCC can be engaged in various ways: • Support the TDA. • Support SAP regarding climate change. • Intergrate SAP in national strategies and action plans for climate change management and adaptation. DCC will participate in national consultation meeting and implementation of pilot project and scientific study and policy and strategy formulation

No	Stakeholders	Stakeholder profiles	Interests and concerns	Engagement
National Level: Ministry of Water Resources and Meteorology				
5	Department of River work and hydrology (DRWH)-MoWRAM	DRWH manages the hydrology and river monitoring data and information in Cambodia. DRWH also provide technical services for realtime monitoring of river water level, flood and drought monitoring and forecasting. DRWH also monitors river sediments and dicharge in Cambodia.	Interests: DRWH is interested in monitoring of groundwater resources in realtime and comparision of groundwater and surface water level. DRWH aims to extend IWRM in groundwater management in Cambodia. Concerns: Lack of groundwater monitoring in Cambodia. The reason groundwater reduction is unclear due to insufficient groundwater monitoring.	DRWH will play an important role in the project in many ways incuding: • Technical support and guidance on surface groundwater dynamics and relevant monitoring systems. • Assist in TDA for groundwater and surface water assessments. • Share hydrological data. DWRH will participate in national consultation meeting and implementation of pilot project and scientific study and policy and strategy formulation
6	Department of Irrigation (DOI)-MoWRAM	DOI is mandated to design and implement irrigation development in Cambodia and leads the development of the national strategy and plan for irrigation project development and improvement.	Interests: DOI is interested in using groundwater resources for irrigation systems in drought prone area. Concerns: limited knowledge and understanding about groundwater resrouces and how these link to irrigation. Also how to better support farmers and the rural poor.	DOI will playing important role in many ways of the project incuding: Devleopment of national SAP regarding groundwater use and the revision of national irirgation plans. Assist in implementation of TDA for groundwater dynamics (recharge & extraction) and effects on ecosystems (e.g. fish, wetlands) and livelihoods.
Cambodia National Mekong Committee (CNMC)				
7	Cambodia National Mekong Committee (CNMC)	CNMC is the mandated national institution to coordinate under direct supervision of the Royal Government of Cambodia the management, preservation, conservation and development of water and other related resources in the Mekong River Basin.	Interests: CNMC is interested in tranboundary groundwater cooperation, development of groundwater strategies and action plans and the joint TDA for groundwater dynamics between Cambodia and Viet Nam which is oart of its mandate under the MRC cooperation framework. Concerns: no concrete action on tranboundary groundwater cooperation has been developed. Knowledge gaps on groundwater dyamics including monitoring data and maps, and limited planning for management and the devleopment of groundwater resources.	CNMC can engage in the project in varous important roles such as : • Support the TDA • Assist as national coordinator for development of transboundary cooperation mechanisms • Provide technical advice and gudiance on transboundary cooperation mechanisms • Assist in design and execution of demonstration studies • Assist in development of strategies and action programs • Interlink and coordiated with MRC • Coordination of data and information sharing with relevant line agencies The Department of Information and Knowledge Management will lead on transboundary cooperation, TDA, SAP, and coordination with MRC.
Tonle Sap Authority (TSA)				
8	Tonle Sap Authority (TSA)	TSA is mandated to provide technical assistance to the RGC for the development of the Tonle Sap catchment, including the development of a national strategy and action plans for the	Interests: TSA is interested in the application of sustiable groundwater management in the Tonle Sap basin, improved monitoring, and improved assessments of surface-groundwater dynamics.	TSA can engage in the project by providing strategic advice on the implementation of the SAP and the coordination of demonstration projects in the Tonle Sap basin as well as sharing data and information.

No	Stakeholders	Stakeholder profiles	Interests and concerns	Engagement
		management of the Tonle Sap basin.	Concerns: limited groundwater data and activities related to groundwater monitoring and mapping of groundwater quality and quantity.	The Department of Natural Resources will participate in the TDA, national consultation meetings and SAP.
Ministry of Rural Development				
9	Department of Rural water supply and sanitation of the Ministry of Rural Development (MRD)	Department of Rural water supply and sanitation plays a key role in supplying clean water to rural households in Cambodia including providing wells and promote hygiene. At provincial level, there is a provincial department of rural devlopment undertaking the implmentation of national key priorities.	Interests: Groundwater monitoring, groundwater mapping, groundwater master plan and identify potential areas for grondwater well installation. Concerns: groundwater quality and quantity decline. Insufficient water supply for rural areas and unsafe water for rural communities.	Department of Rural water supply and sanitation should be involved in this project by many ways: • Mandated to manage rural wells installation, management and maintenance. • Manage groundwater development in rural communities; • Maintains knowledge and data on groundwater and water supply in rural communities. The Department of Rural Water Supply and Sanitation will participate in the TDA, national consultation meetings, SAP and demonstration projects.
Ministry of Woman Affair (MWA)				
10	Ministry of Woman Affair (MWA)	MWA advocates public institutions, civil society and the private sector to integrate gender equality into their policies and programs, and coordinates gender mainstreaming. MWA is responsible for monitoring and evaluating policies and programs to assess gender equality and the empowerment of women.	Interests: Gender mainstreaming and relevant action plans Concerns: gender inequality in groundwater dependent communities and in groundwater management and water supply for rural communities.	MWA can be engaged for the development of national policies and planning and the Gender Action Plan and assist to mainstreaming of gender issues in the national and regional plan. The Department of Gender will participate in the TDA, national consultation meetings and SAP.
Ministry of Agriculture, fishery and forestry				
11	Department of Planning and Statistics (DPS)-MAFF	DPS-MAFF manages all statistical information and detailed planning for the agriculture sector in Cambodia. At prvoicnial level, the department has channels for data collection and undertakes data mining on agricultural planning and development.	Interests: DPS-MAFF wish to intergrate data related to the groundwater information in the agriculture sector and concrete plans on groundwater uses planning for agriculture sector. Concerns: groundwater quality and quantity for agriculture production in rural communities. Lack of available water supply for agricutlural areas and irrigation especially during the dry season.	DPS-MAFF has a potential role by providing clear strategic development plans for agriculture using groundwater resources. This department also have data and information which will be requried for the implementation of the TDA and preparation of the SAP. DPS will participate in TDA, national consultation meeting and policy formulation and implementation of pilot study.
12	General Directorate of Agriculture (GDA) -MAFF	GDA plays a key role in agricutlural land mangement and devleopment including crop	Interests: GDA-MAFF aims to develop crop planning and agriculture production planning using	GDA can engage with the project by providing national plans for crop zoning and management of agriculture land

No	Stakeholders	Stakeholder profiles	Interests and concerns	Engagement
		management and planning, soil fertilitiy mangment and development, and the development of national strategies for agricultural development, soil fertility management, crop zoning and planning.	groundwater information. Develop groundwater mapping for rice production zoning. Concerns: reduction of groundwater recharge, high rate of groundwater extraction and impact of climate change on soil fertility in non-irrigated areas.	zoning. GDA can assist the project for development of the SAP and its implementation in the NAP for agriculture. GDA-MAFF also can provide all necessary data and maps related to soil fertility, crop zoning, agricultural zoning. The GDA will participate in TDA, national consultation meeting and policy formulation and implementation of pilot study.
13	Fisheries Administration – FiA -MAFF	FiA manage the fishery resources management including wild and aquaculture including the fishing lots in Cambodia. FiA also manages two important national institutes on fresh and marine fisheries in Cambodia. FiA also manage the local fishery communities in Cambodia and protection of fishery and ecological functions in Cambodia.	Interests: FiA is interested in conservation of fisheries and aquatic resoruces and also in groundwater uses for aquaculture production. Concerns: rapid loss of wetlands and aquatic resources due to the development in the Mekong Basin. Also the in-balance of groundwater recharge and extraction, which will be leading to the loss of fish stocks and aquatic habitat and ecosystem services in Cambodia.	FiA is playing a vital role in the groundwater project especially related to the TDA and drafting the SAP for consevation of wetland and aquatic habitats in Cambodia. FiA can also help to provide strategic guidance on the impact assessment of groundwater uses on environmental, ecological resources and livelihood of fisheries communities and intergrate the SAP into national actions plan. FiA also can share many important fisheries and aquatic resources data for the TDA. The FiA will participate in TDA, national consultation meeting and policy formulation and implementation of pilot study
Ministry of Foreign Affairs and International Cooperation (MOFAIC)				
14	Ministry of Foreign Affairs and International Cooperation (MOFAIC) Department of Southeast Asian - South Asian - South Pacific Affairs	Government agency with the mandate to guide transboundary negotiations		Support the transboundary dialogue and facilitate cross-sector discussions
PRIVATE SECTOR				
15	CAVAC Innovation Agriculture	CAVAC supports the RGC to improve the quality, sustainability and effectiveness of irriation systems in Cambodia	Innovation of irrigation systems. Sustainable irrigation services to communities. Irigation infrastructure investment and policy advice.	Sharing experiences. Support of policy fourmulation and planning. Assessment of irrigation demand. Participation in the implementation of demonstration projects and policy and national strategy formulation
16	Cambodia Water Partnership (CWP)	CWP is a part of global Water Partnership created to foster IWRM.	IWRM approach; Water resources networking; Tranboundary cooperation; Water governance.	Sharing experiences. Providing scientific experts and technical inputs for TDA. Participation in the implementation of demonstration projects and policy and national strategy formulation

No	Stakeholders	Stakeholder profiles	Interests and concerns	Engagement
17	National universities and research institutes	Universities and research institutes in Cambodia play an important role in research and education related to groundwater, biodiversity, ecology and fisheries.	New findings on groundwater research. Promote sustainable development. Assess the ecosystem services and functions of wetland related to groundwater dynamics.	Sharing experiences. Providing scientific experts and technical input for TDA. Participation in the implementation of demonstration projects and policy and national strategy formulation
NGOs and IGOs				
18	NGOs and IGOs	There are many NGOs (e.g. CCC, NGO Forum, HACC, NEP, CDPO,3S Networking) working in the Cambodia as well as IGOs (e.g. MRC, WB, UNDP, ADB, GIZ, IFAD, OXFAM)	Sustainable management of agriculture, fishery, forestry, water governance, climate change adaptation, gender, socio-economic development. Tranboundary cooperations.	Sharing experiences, data, information and planning. Joint collaboration on some related project activities. Promote and conduct gender mainstraming and contribute to the socio-economic aspects of the TDA. Will provide on-the-ground support to project design and implementation. Will also be periodically engaged based on stakeholder engagement plan (e.g. workshops, technical forum)
Provincial Level (17 provinces and city: Siem Reap, Kampong Thom, Battambang, Bantey Mean Chey, Pursat, Kampong Chnang, Stueng Treng, Kratie Kampong Cham, Takeo, Prey Veng Svay Rieng, Kampot, Sihanoukville, Koh Kong, Kep and Phnom Penh Capital city.)				
	Department of Environment	Province Government Agency responsible for natural resource management and environmental protection.		Provide on-the-ground support to project design and implementation. Will also be periodically engaged based on stakeholder engagement plan (e.g. workshops and meetings). Conducting demonstration projects.
	Departments of Agriculture, Fishery and Forestry	Province Government Agency responsible for planning and monitoring in agriculture, fishery and forestry		
	Department of Rural Development	Provincial management on rural development planning and groundwater investment		
	Department of Water Sources and Meteorology	Provincial management on water resources and irrigation development and investment		
	Department of Women Affair	Provincial management on woman affair, gender mainstreaming, and community development-based gender action plan.		Support to project design and execution regarding gender equality and mainstreaming.
	Local community and individual households			Household survey and village focus group discussions to support TDA and SAP.
International cooperation entities				
	Donor organizations (e.g. GEF, DFAT, AWP, World Bank, ADB, JICA, SIDA, GIZ and AFD, KOICA)			Will be invited to annual Stocktaking Meetings.

Viet Nam:

There are a range of stakeholders involved in groundwater management in Viet Nam's Mekong Delta and its eastern outreach to Ho Chi Minh City. The key stakeholders are identified in Table 15 together with their respective profiles, interests, concerns and potential engagement in this project are presented. Further details for these key stakeholders are provided in Annex P.

The project will ensure information of the project will be made available to the public so that the environmental and social risks and impacts associated with the project, as well as opportunities provided by the project will be informed properly to all stakeholders. This will enable project data, information can be used for decision makers as well as supporting policy building process in Mekong delta provinces.

On an ongoing basis, the project will have a routine disclosure and consultation on the project's environmental and socio-economic performance including grievances and other new emerging issues on the project. The disclosures will be done to all stakeholders' thorough project briefs or annual reporting through brochures. While providing this disclosure, the project will also provide:

- An update on the Project achievements and how its contributing to enhancing transparency in reporting for river basins management in the country
- An overview of the stakeholder engagement process and how affected parties can participate and provide feedback through meeting or other avenues;
- Project impacts on development and how the government is using the project data to enhance the livelihoods of the ethnic people at the same time conserve the environment and report and forecast on river basins water management and climate change related events.

TABLE 15: KEY STAKEHOLDERS AND THEIR ENGAGEMENT DURING THE IMPLEMENTATON PHASE IN VIET NAM

No	Stakeholders	Stakeholder profiles	Interests and concerns	Potential engagement
Ministry of Natural Resources and Environment (MONRE)				
1	Department of Legislation (DOL), MONRE	National focal point for MONRE in the GEF Project		MoNRE will execute parts of the project (e.g. Component 2). All process of the project formulation and implementation
2	Department of International Cooperation (ICD), ONRE	Support for setting up the legal documents for transboundary cooperation between Mekong countries		Participation in national consultation and policy development
3	Department of Water Resources Management (DWRM), MONRE	Setting up the transboundary water cooperation mechanism		Participation in national consultation and policy development
4	Environment Administration (EA), MONRE	Government Agency responsible for the protection of the environment, including endangered species, and the sustainable management of ecosystems, incl. wetlands.		Participation in national consultation and policy development
5	Institute of Meteorology, Hydrology, and Climate Change (IMHEN) - MONRE	Government agency responsible for and providing climate change projections.		Participation in national consultation and policy development
6	Viet Nam Meteorological and Hydrological Administration (VMHA)	Government Agency responsible for Meteorological and hydrological monitoring and forecasting.		Participation in national consultation and policy development
7	Division for Water Resources Planning and investigation for the South of Viet Nam (DWRPIS)	Planning, investigation, reconnaissance, exploration and exploitation of water resources (including thermal water, mineral water and mineral mud). Groundwater exploitation drilling. Groundwater monitoring.		Participation in national consultation and policy development
Ministry of Agriculture and Rural Development (MARD)				
8	Directorate of Water Resources (DWR), Ministry of Agriculture and Rural Development (MARD)	Government agency responsible for developing policies and plans for design, implementation and maintenance of irrigation infrastructure.		Participation in national consultation and policy development
9	General Department of Disaster Prevention and Control (GDDPC), MARD	Government agency responsible for the development of policies, regulation and plans for the prevention of natural disaster prevention and control.		Participation in national consultation and policy development
10	Institute of Water Resources Planning (IWRP), MARD	Government agency responsible for providing the technical support for water resource planning.		Participation in national consultation and policy development
11	Viet Nam Academy for Water Resources (VNWRA), MARD	Government agency responsible for providing the technical support for water resources management and disaster risk reduction.		Participation in national consultation and policy development
12	Directorate of Fisheries (DF), MARD	Government agency responsible for policies, regulation, and management of capture fisheries and aquaculture.		Participation in national consultation and policy development
13	Administration of Forestry (AF) MARD	Government agency with the mandate to provide the technical support for forest management and forest protection.		Participation in national consultation and policy development

No	Stakeholders	Stakeholder profiles	Interests and concerns	Potential engagement
14	Viet Nam National Mekong Committee (VNMC)	Inter-ministry Agency-a focal point of Viet Nam in Mekong River Commission (MRC)		Participation in national consultation and policy development
Ministry of Industry and Trade (MOIT)				
15	General Directory of Energy, Ministry of Industry and Trade (MOIT)	Government agency responsible for the development of policies and plans for energy related investments.		Participation in national consultation and policy development
Ministry of Foreign Affairs (MOFA)				
16	Department of Southeast Asian - South Asian - South Pacific Affairs, MOFA	Government agency with the mandate to guide transboundary negotiations.		Will support the transboundary dialogue and facilitate the cross-sector discussion.
Ministry of Planning and Investment (MPI)				
17	Department of Science, Education, Natural Resources and Environment	Government agency responsible for management over planning and investment for natural resources and environment; coping with climate change; low emission development, green growth		Will examine, monitor the implementation of the project
Ministry of Finance (MOF)				
18	Department of International Relation	Coordinating to build integration negotiation plans, consulting ideas with ministries and agencies in negotiating, signing treaties and international agreements.		
National CSOs				
19	National CSOs: Viet Nam River Network (VRN), Sustainable Agriculture and Environment Development, VRCR: Viet Nam Red Cross Union, Some NGOs under Viet Nam Union of Science and Technology Associations (VUSTA)	Various CSOs that focus on sustainable development in the two target basins.	Will provide on-the-ground support to project design and implementation. Will also be periodically engaged based on stakeholder engagement plan (e.g. workshops, stocktaking)	
Provincial Level **(**13 provinces and city: Tien Giang, Long An, Dong Thap, Ben Tre, Vinh Long, Kien Giang, Can Tho, Soc Trang, Bac Lieu, Tra Vinh, Ca Mau, An Giang and Hau Giang, and Ho Chi Minh city				
20	DONRE: Department of Natural Resources and Environment	Province Government Agency responsible for the management of natural resources and the protection of the environment. DONRE plays a key role in management of natural resources and environmental protection in the province.	Need trans-boundary water and natural resources management; Need effective regional planning in the VMD; How to involve (difficult to involve) enterprises, other stakeholders in water management; Environmental pollution; Reduction of wetland, forest, biodiversity;	DONRE should be involved in this project by many ways: • Have power in term of land and water management in the province ⇔ management at landscape level; • Share data and information regarding to natural resources, environmental quality, land use, etc.; • Have capacity to apply technology in management of natural resources and environment.

No	Stakeholders	Stakeholder profiles	Interests and concerns	Potential engagement
		At district level, there is a Sub-DONRE. At commune level: there is a staff per commune responsible for natural resources and environmental management.	Inconsistent legal framework.	Will provide on-the-ground support to project design and implementation. Will also be periodically engaged based on stakeholder engagement plan (e.g. workshops and meetings). Conducting demonstration projects at the project sites.
21	DARD: Department of Agriculture and Rural Development	Province Government Agency responsible for planning and monitoring in agriculture and rural development. DARD plays a key role in management of agriculture and development of rural area in the province. At district level it is called Sub-DARD At commune level, it has 1-3 staff per commune	What are alternative crops to reduce water use? Market problems: unstable price of all agricultural products, increasing input prices; Lack of successful demonstration, package of hi-tech, cooperative, adaptation to climate change; Small-scale farming, lack of cooperation; Overuse of agri-chemicals causing water pollution; Upper hydropower dams.	DARD may be engaged by many ways: • Provide technical and experienced staff; • Implement and monitor demonstration, transfer of technology; • Connect with farmers and private companies for better collaboration; • Co-operate with their current projects and programs (agricultural extension, new rural development, one commune one product, etc). Will provide on-the-ground support to project design and implementation. Will also be periodically engaged based on stakeholder engagement plan (e.g. workshops and meetings). Conducting demonstration projects at the project sites.
22	Department of Planning and Investment (DPI)	Provincial management on planning and investments		Will provide on-the-ground support to project design and implementation. Will also be periodically engaged based on stakeholder engagement plan (e.g. workshops and meetings). Conducting demonstration projects at the project sites.
23	Department of Industry and Trade (DIT)	Provincial management on energy and industry development (hydro power management, processing industry…)		Will provide on-the-ground support to project design and implementation. Will also be periodically engaged based on stakeholder engagement plan (e.g. workshops and meetings). Conducting demonstration projects at the project sites.
24	Provincial Women Union, Farmer Union, Youth Union, and Ethnic Committee	Social organizations responsible for social affairs, social network and mobilization		Will provide on-the-ground support to project design and implementation. Mainly on awareness raising events, livelihood strategies, land use change, and land management. Demonstration project design will consider livelihood development on project sites
25	PCONRD: Program Coordination Office of the National Target Program on New Rural Development	Under DARD or People Committee, to implement effectively NTP on new rural development	Socio-economic development in rural area; Rural nfrastructure improvement; Environmental protection; Cultural conservation; Capacity building for rural people.	Integrate with existing activities to improve rural livelihoods and living conditions (trainings, job creation, technology transfer, one comemune one product, etc.).

No	Stakeholders	Stakeholder profiles	Interests and concerns	Potential engagement
26	DOLISA: Department of Labors, Invalids and Social Affairs	DOLISA performs state management function on the following areas of labor, wage and salary, employment, vocational education, social insurances, occupational safety and hygiene, people with special contribution to the country, social protection, children related issues, gender equality, social vices control and prevention in the province.	High poverty rate, especially in remote areas and minority groups; Low education of the poor, Chemical use in agriculture ⇔ health related issues and environmental pollution; Not attract young labors in the province; Migration to cities, industrial parks and oversea (exporting labors)	DOLISA have staff, school for vocational training; It may help to carry out activities related to poverty reduction, children, gender, minority groups, vulnerable people, vocational education;
27	VNWU: Vietnamese Women's Union	Similar to VNFU, VNWU has the same role as social-political organization but focusing more on women and children. It also has the same structure, organizing from national level to provincial, district, commune and hamlet.	Contamination, unsafety food, chemical residue on vegetables; Environmental pollution, climate change affects to women and children; Lack of knowledge on climate change Vocational education for women, ensuring stable jobs, high income; Improve roles of women in family and society.	Similar to VNFU, there are some opportunities for collaboration with VNFU in our project such as: VNWU has good structure to grass-root level, staffs from center to province, district, commune and hamlet. VNWU has collaboration with related Departments ⇔ good network. VNWU has its own budget to support women and children.
28	Regional university and research Institutes	Universities and research institutes in the region play an important role in research and education in the Mekong Delta	Among the best education centers Sustainable development Climate change adaptation	Sharing experiences Providing scientific experts Implementing demonstration project sites, demonstration Collaborating with the local governments and departments
29	Ethnic minorities communities' groups, individual households			Household survey and village focus group discussions to support TDA and SAP. Mainly eliciting livelihood strategies, risk perceptions, and likely behavioral responses and participation in livelihood development activities.
30	Agricultural Cooperative	Cooperative is considered as a production unit and operated under Law of Cooperative. Their key role is getting farmers together for large scale production, better incomes, easier to implement governmental policies.	Leadership: Low education, lack of skill and knowledge; Lack of strategy and planning; Contract farming broken; Issues related to transparency, book keeping, benefit sharing; Members do not believe in cooperatives;	They already have structure. The project should make use of these organizations to demonstrate how (ground) water use and management in efficient way
Private Sector				
31	VNFU:Vietnamese Farmer's Union	VNFU is a social-political organization of Viet Nam's peasantry under the leadership of the Communist Party. VNFU has	Small scale farming, too much chemical use, conventional practices, difficult to change farmers behavior; Climate change impacts;	VNFU has good structure to grass-root level, staffs from center to province, district, commune and hamlet. This structure can be used to increase farmer awareness under project implementation and after;

No	Stakeholders	Stakeholder profiles	Interests and concerns	Potential engagement
		been playing a key and central role in farmers' movements and building new rural areas.	Fluctuation of agricultural product prices; Migration to cities, industrial parks; Weak human resources (qualified) in VNFU system at all level.	VNFU has collaboration with related Departments ⇔ good network. VNFU has its own budget (farmer supporting funds) to help farmers.
32	Viet Nam Dairy Products Joint Stock Company (Vinamilk), Branch in Can Thơ city	Vinamilk is Viet Nam's largest dairy company, which produces a wide range of dairy products for the domestic and export markets.		Participation in the implementation of demonstration projects.
33	Angiang Fisheries Import Export Joint Stock Company	Angiang Fisheries is a Viet Nam-based seafood processing *company*. It primarily manufactures, processes, markets, and *exports* aquatic frozen seafood and agricultural products, as well as merchandises materials and equipment for agricultural activities		Participation in the implementation of demonstration projects.
34	Minh Phu Seafood Cooperation	Minh Phu is Viet Nam's biggest seafood processing company in the Mekong delta		Participation in the implementation of demonstration projects.
Other Stakeholders				
35	Donor organizations (e.g. GEF, DFAT, AWP, World Bank, ADB, JICA, SWaM, SIDA, GIZ, UNDP)			Will be invited to annual Stocktaking Meetings.
36	Alliance for Water Stewardship	Recognizes best practice water management by industry		Facilitate private sector engagement
37	NGOs and IGOs	There are many NGOs working in the Mekong Delta as well as IGOs (e.g. MRC, WB, UNDP, GIZ, IFAD)	Sustainable agriculture, organic agriculture, aquaculture, forestry, water governance, climate change adaptation, gender, socio-economic development, etc.	Sharing experiences; Collaboration on some related activities; Negotiating with other upper stream countries Will be invited to the annual Stocktaking Meetings

3. Gender Equality and Women's Empowerment.

Does the project expect to include any gender-responsive measures to address gender gaps or promote gender equality and women's empowerment? (yes ☒ /no☐) If yes, please explain and upload/annex **Gender Action Plan** or equivalent. **Annex N2**

If possible, indicate in which results area(s) the project is expected to contribute to gender equality:

☒ closing gender gaps in access to and control over natural resources;

☒ improving women's participation and decision making; and or

☒ generating socio-economic benefits or services for women.

Does the project's results framework or logical framework include gender-sensitive indicators? (yes ☒ /no ☐)

Viet Nam recognizes gender equality as key component for sustainable agricultural development, including water management. Viet Nam has made significant progress in promoting gender equality in all sectors by endorsement or revision of legal frameworks and policies on gender equality and the advancement of women, most notably the Gender Equality Law and the National Strategy for Gender Equality. This reflects Viet Nam's commitment to Gender Equality and a range of international conventions and national commitments the Government ratified. However, there still exist gender gaps in agriculture and the water sector in Viet Nam's Mekong Delta: (i) poor sanitation, water borne diseases, health problems; (ii) participation in decision making and capacity building/training; and (iii) economic conditions and income.

In Cambodia, there are no existing legal instruments, strategies and action plans advancing gender equality in the context of groundwater access and management. Focus group discussions during the PPG field missions confirmed that although women are mainly responsible for collecting groundwater for household consumption, only 30 percent of the management committee members for tube wells in five visited provinces are women. Furthermore, although women are in charge of collecting groundwater for households and short-term vegetables cultivation, technologies (e.g. irrigation timers, comfortable water collection methods) that could reduce their burden are extremely limited.

The project will be aligned with the GEFs and FAOs Policies on Gender Equality, the FAO Regional Gender Strategy and Action Plan for Asia and the Pacific, and the GEF Gender Implementation Strategy. The project is also in line with SDG 5 on Gender Equality, and the empowerment of women and girls, and it will therefore put efforts to improve the participation of women in decision-making, particularly in groundwater management and irrigation, and in the design and implementation of effective transboundary institutions. A Gender Integration and Equality Approach for Transboundary Aquifers has been specifically developed for this project, with the overall goal of ensuring an equitable participation of women and ethnic minorities in project activities, and of fostering the empowerment of women in the Mekong Delta Transboundary Aquifer, responding to the gender equality challenges listed above. It aims at providing a roadmap for full integration of gender considerations into the project long-term Vision as well as inform and contribute to the SAP preparation. Details are provided in Annex N2.

The Water and Gender Action Plan (GAP) is provided in Annex N to ensure that gender considerations are considered during project formulation through a gender-responsive approach, and through specific activities directed to strengthen women's participation in decision-making.

During early project implementation, gender actions will be consolidated into a Mekong Delta aquifer focused Gender Strategy, that will include, among others, the following interventions:

- TDA, including gender analysis
- Capacity development to national stakeholders on the impacts of groundwater management and aquifer recharge on women and men's livelihoods.
- Creation of a system with Gender Focal Points at national and regional levels to share information related to gender issues in groundwater management and groundwater dependent livelihoods.

4. Private Sector Engagement.

The agricultural Sector in Cambodia and Viet Nam are at the beginning of a rapid mechanization trend, in which public-private partnerships play an important role. This involves also the surge in irrigation expansion, in particular in Cambodia. These development plans involve the increased utilization of groundwater. In Viet Nam, private sector investments are not just critical for the rice sector but also for the rapidly expanding aquaculture sector. The latter is perceived as a major driver for recent increases in groundwater utilization.

Against this backdrop it is paramount to engage with the private sector investing in agriculture in Cambodia and Viet Nam. This is likely to include consultations with the Hong Kong based Green Leader Holdings Group with its cassava focused investments in Cambodia, Golden Rice (Cambodia), Gentraco (Viet Nam), and Southern Seed Corporation (Viet Nam). Under Component 5, output 5.2 will focus amongst others on providing opportunities for exchanges with and engagement of the private sector.

List of Private Sectors	Types of business	Relevant to the project / Objective	Location	Form of engagement
Phnom Penh Water Supply Authority	Water supply	Water treatment and development of urban water supply system	Phnom Penh	Included in the list of stakeholder consultation for preparation of SAP
Niroth Water Treatment Plant	Water supply		Phnom Penh	
Kampong cham water supply	Water supply	Surface and Groundwater supply system for urban	Kampong Cham	Stakeholder engagement meeting on Project implementation phase on design for groundwater use for urban and community
ANCO Water Supply	Water supply		Preah Sihanouk	
Siem Reap Water Supply	Water supply		Siem Reap	
WE Venture Co. Ltd	Water supply	Safe water for urban and rural community	Phnom Penh	
24/7 Private Water Operators	Water supply	Groundwater user for urban water supply	23 provinces	
ENVICARE WATER CO., LTD	Water supply		Phnom Penh	
Sala 5 Water Supply	Water supply		Kampong Chhnang	
Kompongchomlong Water Supply	Water supply		Prey Veng	
Mong Rithy Group	Agriculture and food production	Innovation and technology for Agriculture production and food processing	Sihanoukville, Kampong Spue, Kampot	Engage in sharing of technology and innovation technology for high agriculture production and food processing
Golden Rice	Rice exporter	Rice harvesting technology for export	Country-wide	
CP Cambodia	Food processing	Animal and food processing technology	Phnom Penh and Siem Reap	
Baca-Villa Productions Co Ltd	Agriculture	Rice harvesting, animal and food processing technology and fertilizer technology	Siem Reap	
Harvest Centre (Cambodia) Co., Ltd	Agriculture exporter		Phnom Penh	
Viet Nam Dairy Products Joint Stock Company (Vinamilk)	Dairy products	Major water user, food processing	Can Thơ city	
Minh Phu Seafood Cooperation	Largest seafood processing company in the Mekong delta	Major water user, main client for many aquaculture farms in the Mekong delta.	Ca Mau	
Angiang Fisheries Import Export Join Stock Company	Fisheries	Major water user, fisheries and fish farming	Long Xuyen city, An Giang Province	

5. Risks.

Part A of this section focuses on external risks to the project and Part B on the identified environmental and social risks from the project.

Section A: Risks to the project

In the section below, elaborate on indicated risks **to the project**, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and, if possible, the proposed measures that address these risks at the time of project implementation.

Description of risk	Impact[1]	Probability of occurence	Mitigation actions	Responsible party
Risks related to COVID-19: a) Delays due to COVID-19 lead to slow implementation or stalling, and/or impacts the stakeholder engagement process. b) Impacts from COVID-19 affects the availability of technical expertise and capacity. c) Enabling environment and changing government priorities/ availability of co-financing. d) Future risks of similar crises (including from human-livestock-wildlife interaction)	M	Medium	Potential impacts of COVID-19 will be closely monitored. a) The project will implement adaptive management, and the work plan and stakeholder engagement plan would be adjusted, if necessary, to reflect the impacts of COVID-19. It is anticipated that, even if face-to-face interactions are reduced, the project would still be able to organize meaningful consultations with local stakeholders through the local representatives. Remote communication via email, online meetings and phone may be used increasingly to adjust to the new situation. b) It is not currently anticipated that the COVID-19 restrictions would affect the availability of national expertise. The project relies mostly on national experts for its implementation. With regard to any international experts, it is expected that expertise could be provided remotely, if necessary. c) As explained above, increasing exports as well as environmental protection, poverty alleviation, and green economic recovery are among the priorities of the Governments, which is aligned with the GEF-7 project goals. Measures are being developed under the socioeconomic response frameworks and the COVID response plans both Governments have put in place. These aim to support the socio-economic recovery and increase resilience. Availability of co-financing is not anticipated to be affected due to the additional investments in the COVID-19 response. d) The GEF-7 project will ensure implementation of the One Health	IUCN (PMU)

[1] H: High; M: Moderate; L: Low.

			approach, contributing to a coordinated approach in promoting public health, animal health, plant health and environmental outcomes, including in the area of human-livestock-wildlife interface. The project will increase communication and collaboration between human, animal, and environmental health professionals. The project will ensure that all project team members are aware of the zoonotic risks and minimise these in field trip approval protocols. The project will monitor where possible zoonosis reated risks, report on them to the SC and implement rapid risk mitigation measures where necessary.	
Ensuring effective multi-stakeholder involvement from both countries can be time and resource consuming – specially to ensure that people and institutions involved effectively represent their sector or stakeholders	H		The project will facilitate roundtables and task forces to ensure that knowledge is being shared among different stakeholders, and that the views of different groups are being taken into consideration.	IUCN (PMU)
Climate risks including incorrect assumptions regarding future climate change trajectories.	M		Historical, current and future projected changes in climate will be incorporated as an integral part of the planned assessments and management plans in the project. The differing adaptive capacities between the two countries will be considered when devising strategies to manage climate risks.	UNESCO IHP, IUCN (PMU)
Demonstration projects are successfully designed for current climate conditions but fail for future climate conditions (e.g. increasing variability).	H		The demonstration projects will be assessed against the backdrop of a wide range of climate change scenarios and safeguards will be applied.	UNESCO IHP, IUCN (PMU)
Lack of sustained political support to establishing transboundary	M		The project will adopt a step by step progressive approach to building mutual trust based on joint fact finding and consultative processes. It will build upon, and support compliance to the	IUCN (PMU)

cooperation frameworks.			MoU recently signed between the two beneficiary countries.	
Limited interest or involvement by target stakeholders, local communities and the inhabitants of the two basins.	M		The risk will be addressed throughout project implementation through systematic communication with local communities and other stakeholders, and through their involvement in the Annual Stocktaking Meetings. To further reduce this risk, a highly participatory approach will be used to design, evaluate and upscale pilots with communities, CSOs and other relevant stakeholders on the ground. Based on our experience working in the CMDA area, farmers are willing to invest in flood friendly crops and other NBS when there are clear economic benefits. Accordingly, we will organize experiential study visits, and farmer to farmer exchanges to further minimise engagement related risks. These measures will not only increase the real-world impacts of this project but also create meaningful ownership among relevant stakeholders, which from experience creates substantial interest in engaging with the project.	IUCN (PMU)
National processes – particularly approvals for plans and legal mechanisms – may be complex and lead to uneven progress between countries that may undermine different countries interest/ engagement	H		The project will facilitate knowledge sharing and provide guidance based on lessons learned and other similar experiences – but this will not affect the normal processes in each country, and it is expected that countries will move at difference paces. When necessary, informal discussion forums (e.g. regional workshops) at the same time formal processes (e.g. setting up an advisory group) are being set up, to avoid time lags.	IUCN (PMU)

Weak participatory processes, with no meaningful integration of the often under represented (marginalized) households depending on irrigated agriculture and aquaculture.	H		The project has gone through an extensive consultation process but has been limited to the national and regional levels – the project needs to be brought to the local level to assess that it will have a positive impact on households and responsive to their needs. During the PPG phase or early implementation, once demonstration project locations have been decided, the project will follow the Free Prior and Informed consent methodology to inform coastal fishing communities about the aims of the project and obtain their approval to participate.	IUCN (PMU)

COVID-19 pandemic: Short, medium, and long-term effects

COVID-19 impacts on the life of Southeast Asian countries have suddenly increased in January 2021 after experiencing very low number of cases for the first ten months of the global pandemic. According to the John Hopkins University of Medicine statistics (accessed 29 September 2021) Viet Nam has so far had 770.640 cases and 18.936 deaths. Only 8 286 558 people have been fully vaccinated, representing 8.59 percent of the population. However, 39m doses have been administered, indicating that the vaccination program is now rapidly improving. Cambodia had so far 110.792 cases and 2.287 deaths, while 23.8M people 66 percent of the population being already fully vaccinated.

The early design of the proposed project has taken steps to minimize the risks related to the COVID-19 global pandemic in the area of community health. While the project will not directly generate risks related to construction or hazardous materials, there is a risk that travel to or from areas where COVID-19 is prevalent could pose a risk to the population of Cambodia and Viet Nam, and to project staff, consultants/contractors. The project detailed design will include active steps to mitigate this risk, including training on pandemic-related guidance for project staff and stakeholders during the inception phase, and the expansion of standard monitoring of project operations and ensure that they are in conformity with FAO policies regarding travel, risk reduction, and other areas regarding the COVID-19 pandemic. The Project Manager will report on compliance to the Project Steering Committee and take any necessary steps to protect the health of staff, consultants/contractors, and beneficiaries required by the situation.

The COVID-19 pandemic affects jobs and livelihoods in many sectors, including those related to freshwater resources. The proposed project will improve the resilience of communities to climate change, conservation of the integrity of freshwater ecosystems, and fostering environmentally sustainable water resources management, which in combination will improve the COVID related recovery process and improve the long-term resilience of communities to future shocks.

Section B: Environmental and Social risks <u>from the project</u> – ESM Plan

This section is based on the risk matrix obtained during risk screening in the concept note (in FPMIS) and based on further update and revision by the PTF under the responsibility of the LTO.

Project Risk Certification

Entity Number: 673261
Project Title: Enhancing sustainability of the Transboundary Cambodia - Mekong River Delta Aquifer
Recipient Country(ies): Regional Asia & Pacific
Estimated total budget in USD: USD 15 000 000

Risk Certification

Certified by: Whiting, Louise (RAPDD)

Date: 17-Feb-2020

The proposed action is classified as: **Low**

<u>6. Institutional Arrangements and Coordination.</u>

6.a Institutional arrangements for project implementation.

Upon approval of the project, FAO, in its capacity as implementing agency, initiated a consultation with the counterparts in Cambodia and Viet Nam, to identify the suitable execution partner(s) for the technical assistance components.

The process as agreed with the lead agencies from Cambodia and Viet Nam was as follows:

1. Identification and initial assessment of potential partners by all parties.
2. Invitation to submit an execution proposal proposals to identified potential partners
3. Contact with candidates to confirm their interest and request their written proposals.
4. Review and technical evaluation of proposals
5. Recommendation of Operation Partner or Consortium of Operational Partners to Government Agencies, based on proposals received.

In the first step, nine (9) organisations were identified as potential partners. These included: AIT, ICEM, IGRAC, IUCN, IWMI, MRC, MERFI, UNESCO and WWF. Their capacities were initially assessed (step 1) by your agencies and FAO via agreed evaluation criteria, based on current knowledge and experience, in January 2021. Following the conclusion initial assessment, it was agreed to proceed to an Invitation for Proposals.

For the written proposal step, FAO initiated a formal and transparent procedure to identify Operational Partners, through their proposals for the execution of the CMDA project. An internal FAO technical evaluation panel comprising of experienced and technically competent FAO staff members was established, and evaluation criteria already agreed in step 1 were further enriched, to allow in-depth technical evaluation in order to advice Governments of both countries. On 29 March 2021, FAO issued an Invitation for Proposals to the select nine (9) organisations identified in step 1. These were invited to submit a full proposal to become Operational Partners for the execution of the CMDA project, in its entirety or for specific components. A total of six (6) proposals for the execution of the projects in its entirety or specific components were received and reviewed. Based on the evaluation results, FAO and the lead government agencies from Cambodia and

Viet Nam, agreed on the execution arrangements featured in Table 16 and in Figure 21. Execution partners were selected at Output level based on their respective strengths. The International Union for Conservation of Nature, IUCN, has been selected as the overall lead execution agency (Lead Operational Partner, LOP) that will be responsible for coordinating the Regional Project Management Unit (RPMU). IUCN will be in charge of subcontracting the services of the Mekong Region Futures Institute (MERFI) as Operational Partner, and will coordinate the work with the United Nations Educational, Scientific and Cultural Organization, UNESCO (International Hydrological Programme, IHP & World Water Assessment Programme, WWAP) as Operational Partner. UNESCO will be contracted directly by FAO through a UN to UN agreement. Operational Partners also include in Cambodia the General Directorate of Environmental Knolwedge and Information (GDEKI), under the Ministery of Environment (MOE) and potentially MOWRAM, MOE/PDOE, MRD, MAFF/PDAFF, depending on their capacity assessments. In Viet Nam, Operational Partners include Department of Legal Affairs(DLA) under the Ministry of Natural Resources and Environment (MONRE) and potentially MONRE/DONRE and MARD/DARD, according to capacities for the execution of Pilots in Component 2. Further to the above, the National Mekong Commissions, Cambodia National Mekong Commission (CNMC) and Viet Nam National Mekong Commission (VNMC) will be subcontracted by IUCN to support the delivery of Components 3, 4 and 5. All operational partners will be responsible and accountable to FAO for the timely implementation of the agreed project results, operational oversight of implementation activities, timely reporting, and for effective use of GEF resources for the intended purposes and in line with FAO and GEF policy requirements.

Component 1 (TDA) will be executed by UNESCO (IHP & WWAP) and MERFI, as shown in Table 16. The disciplinary split has been made based on the experiences and strengths of these organisations. UNESCO will undertake the groundwater assessment (Output 1.1.) and related dependencies of ecosystems (Output 1.2.). MERFI will conduct the integrated assessment as part of Output 1.3 and will therefore be responsible for merging disciplinary TDA components into one consistent TDA report and will further elaborate on the environmental Status indicators (Output 1.4).

Component 2 (Pilots) will be executed by the two countries. The final selection of executing agencies will depend on the respective government mandate and the related capacities. Consequently, the ultimate selection of pilots will determine the specific execution arrangements for Component 2. Main executing agencies for pilots (pending on capacity assesments) will be in Viet Nam MONRE/DONRE and MARD/DARD, and in Cambodia MOWRAM, MOE/PDOE, MRD, and MAFF/PDAFF.

Component 3 will be executed by UNESCO and IUCN, with the support of the CNMC, the VNMC, and MERFI.

Component 4 will be executed by IUCN with the support CNMC, VNMC, and MERFI.

Component 5 will mainly be executed by IUCN while UNESCO WWAP takes on the lead of the gender focused Output 5.3, complementing its gender assessment role in the TDA. Support for Component 5 activities will be provided by UNESCO IHP and MERFI.

TABLE 16: EXECUTION ARRANGEMENTS

Lead Operational Partner: IUCN			
Component	**Output**	**Operational Partner**	**Support**
Component 1 (Technical Assistance) Joint science-based diagnostic for groundwater dynamics (recharge and extraction) and effects on ecosystems (e.g. fish, wetlands) and livelihoods	**Output 1.1** Assessment of current state of groundwater resources, recharge and extraction dynamics	UNESCO-IHP	IUCN
	Output 1.2 Analysis of groundwater related dependencies of related ecosystems	UNESCO-IHP	MERFI, government agencies as needed IUCN
	Output 1.3: Agreed upon Transboundary Diagnostic Analysis (TDA), including assessment of related governance, socio- economic, legal and gender aspects.	MERFI	UNESCO-WWAP IUCN
	Output 1.4: Agreement reached on Environmental Status Indicators.C2	MERFI	IUCN
Component 2 (investment) Piloting solutions for improved transboundary groundwater management	**Output 2.1:** Pilot demonstrations of innovative groundwater management and utilization after adequate feasibility studies	Viet Nam: MONRE/DONRE, MARD/DARD; Cambodia: MOWRAM, MOE/PDOE, MRD, MAFF/PDAFF	NMCs, technical support from IUCN or other partners as needed
Component 3 (Technical Assistance) Transboundary cooperation mechanisms	**Output 3.1:** Harmonized design of groundwater monitoring networks and protocols	UNESCO-IHP	MERFI, CNMC, VNMC and government agencies
	Output 3.2: Agreement on groundwater data exchange mechanisms and procedures.	UNESCO-IHP	IUCN, CNMC, VNMC, MERFI, UNESCO-WWAP and government agencies

	Output 3.3: Design of permanent transboundary consultation and coordination body (TCCB)	IUCN	CNMC, VNMC, and relevant government agencies
Component 4 (Technical Assistance) Joint strategies and action programs	**Output 4.1:** Countries establish ad hoc inter-ministerial committees.	IUCN	CNMC and VNMC
	Output 4.2: A shared long-term Vision (horizon 20 years) including the agreement on environmental quality targets.	IUCN	MERFI, UNESCO-WWAP
	Output 4.3: Strategic Action Program (SAP) with horizon of 5 years, consistent with the Shared Vision.	IUCN	MERFI, CNMC, VNMC, UNESCO-WWAP, relevant government agencies
Component 5 (Technical Assistance) Reinforced institutional capacity, improved participation, gender mainstreaming, monitoring and coordination.	**Output 5.1**: Structured capacity building in groundwater governance for decision makers and other stakeholders.	IUCN	UNESCO-IHP, UNESCO-WWAP
	Output 5.2: Annual stocktaking and awareness raising meetings with relevant stakeholders (e.g. local, national and regional meetings)	IUCN	All
	Output 5.3: Water and Gender Action Plans and indicators, based on results of Component 1, adopted by relevant authorities in both countries	UNESCO-WWAP	All
	Output 5.4: Periodic events for the coordination with other ongoing initiatives organized by the PMU/TCCB	IUCN	All
	Output 5.5: Full participation to GEF IW LEARN activities, creation of a project website, and preparation of experience notes.	IUCN	UNESCO-WWAP, All OPs

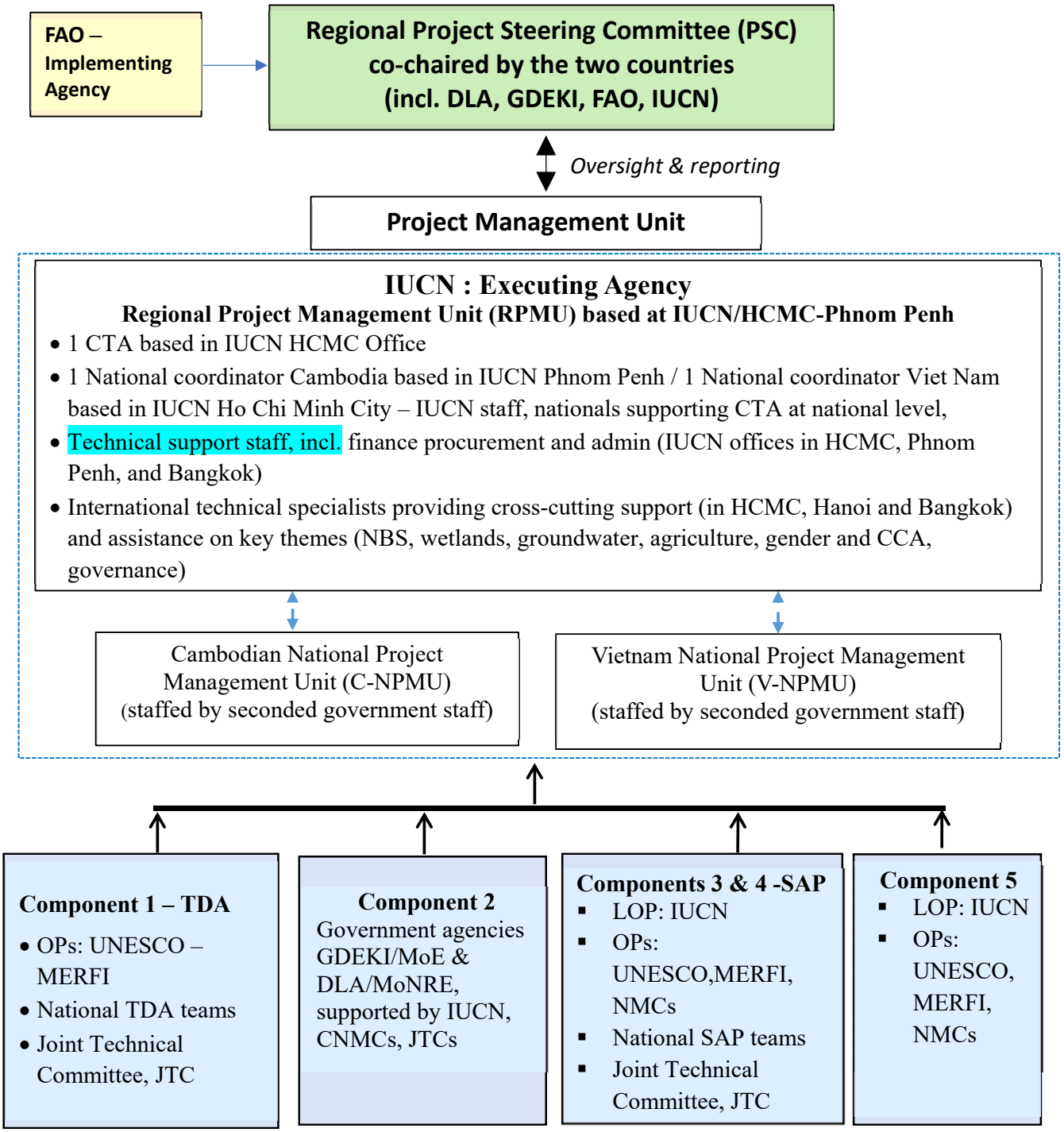


FIGURE 21: EXECUTION ARRANGEMENT SCHEME (CREATED BY AUTHORS)

FAO is the implementing agency and has the ultimate responsibility to GEF for delivering all milestones according to work plan. The GEF will make its payments based on these milestones. It should be noted that the identified Operational Partner(s) or OP results to be implemented by the OP and budgets to be transferred to the OP are non-binding and may change due to FAO internal partnership and agreement procedures which have not yet been concluded at the time of submission of this funding proposal.

Figure 21 visualises the institutional arrangements for this projects according to GEF and FAO rules and considering the transboundary groups the project aims to establish. Component 1 (TDA) will be conducted by two national teams of consultants. An international team of experts designs and reviews the national

assessments across a range of relevant disciplines, and will then synthesise the national assessments into a transboundary assessment report. This component will also include an assessment of pilot project ideas to inform the selection of pilots for Component 2. Components 3 and 4 cover the various steps of the SAP process, starting with the establishment of the Joint Technical Committee(s) (JTC), the Transboundary Consultation and Coordination Body (TCCB), and the Interministerial Committee (IMC). These groups are meant to create a sustainable structure that maintains transboundary management of the CMDA beyond the lifetime of the project. The JTC will be involved in the TDA and in the SAP while the TCCB and the IMC will mainly be involved in the SAP (Components 3 and 4). The SAP steps will involve a visioning process for the transboundary context of the CMDA followed by the drafting of strategic actions, which will be prioritized and tested in pilots based on TDA results and recommendations from Component 1. Component 5 will provide project wide support by delivering on cross-component activities, including capacity building, gender mainstreaming, and communication.

IUCN will have the executing and technical responsibility for the project, with FAO providing oversight as GEF Agency as described below. IUCN will act as the lead executing agency and will be responsible for the day-to-day management of project results entrusted to it in full compliance with all terms and conditions of the Operational Partnership Agreement to be signed with FAO. As Lead Operational Partner (LOP) of the project, IUCN is responsible and accountable to FAO for the timely implementation of the agreed project results under its direct responsibility, and in collaboration with UNESCO for their inputs, coordination among all operational partners and contractors, operational oversight of implementation activities, timely reporting, and for effective use of GEF resources for the intended purposes and in line with FAO and GEF policy requirements.

IUCN's major responsibilities are:

1. Management: set up and operationalize the Regional Project Management Unit (RPMU) to be based in HCMC or Phnom Penh, and oversee all project activities, liaise with FAO and coordinate with other OPs and development partners, set up and operationalize the Regional Project Steering Committee (PSC), handle technical and financial reporting, facilitate national and transboundary coordination across multiple stakeholders.
2. Technical: play supporting technical role in the TDA/SAP to ensure that these processes and outputs meet GEF standards, integrate the latest knowledge and expertise into the TDA/SAP and pilot projects so that they are mutually reinforcing, ensure that TDA/SAP are aligned and coordinated with relevant institutional reforms, provide direct technical expertise on water governance and on nature-based solutions (NbS) including FLR and EBA, design and lead training programmes in both countries.
3. Procurement: recruit Chief Technical Advisor (CTA), National Project Coordinators (NPCs), and other positions described in the ProDoc, contract MERFI, CNMC and VNCM and individual consultants needed to deliver successful TDA/SAP and pilot projects, and ensure compliance with FAO and GEF guidance as well as IUCN procurement rules.

In addition to playing the lead management and procurement role, IUCN will provide technical expertise in the following areas: water governance and policy, agro-ecology (agriculture/aquaculture, climate change, NbS, landscape restoration), hydrology (agriculture, irrigation, and IWRM), ecology (biodiversity and wetlands) and gender. IUCN will source this expertise from existing in-country and regional staff. The ability to "buy into" existing capacity enhances IUCN's contribution in terms of both technical expertise and value for money.

A **National Project Director (NPD)** will be deignated by each government. Located in GDEKI, Cambodia and in DLA, Viet Nam respectively, the NPDs will be responsible for coordinating the activities with all the national bodies related to the different project components, as well as with the

project partners. They will also be responsible for supervising and guiding the Project Coordinator on the government policies and priorities. The NPDs in each country will co-chair the Regional Project Steering Committee (PSC) which will be the main governing body of the project.

A **regional Project Steering Committee (PSC)** will be established to provide strategic guidance to the Project Management Unit and to all executing partners.and take decisions related to the project implementation including approval of annual work plans and budgets and revisions on an annual basis. The PSC will be comprised of representatives from DLA, GDEKI, FAO and IUCN. The NPD in each country will co-chair the Regional Project Steering Committee (PSC) which will be the main governing body of the project.

The members of the PSC will each assure the role of a Focal Point for the project in their respective agencies. Hence, the project will have a Focal Point in each concerned institution. As Focal Points in their agency, the concerned PSC members will: (i) technically oversee activities in their sector; (ii) ensure a fluid two-way exchange of information and knowledge between their agency and the project; (iii) facilitate coordination and links between the project activities and the work plan of their agency; and (iv) facilitate the provision of co-financing to the project.

The RPMU CTA and NPCs will serve as Secretaries to the PSC. The PSC will meet at least twice per year to ensure:

i) Oversight and assurance of technical quality of outputs;
ii) Close linkages between the project and other ongoing projects and programmes relevant to the project;
iii) Timely availability and effectiveness of co-financing support;
iv) Sustainability of key project outcomes, including up-scaling and replication;
v) Effective coordination of governmental partners work under this project;
vi) Approval of the six-monthly Project Progress and Financial Reports, the Annual Work Plan and Budget;
vii) Making by consensus, management decisions when guidance is required by the National Project Coordinator of the PMU.

A Project Management Unit (PMU) consists of the RPMU and the two National PMUs (NPMU). The PMU will be co-funded by the GEF grant.. The RPMU will be located in HCMC, the Vietnam NPMU (V-NPMU) will be based in Hanoi, and the Cambodian NPMU (C-NPMU) will be based in Phnom Penh. The main functions of the PMU, following the guidance of the Project Steering Committee, are to ensure overall efficient management, coordination, implementation and monitoring of the project through the effective implementation of the annual work plans and budgets (AWP/Bs). The RPMU will be composed of an international CTA, two National Project Coordinators (NPCs), Technical Support Officers, including Finance, Administration and procurement officers, who will work for the project lifetime to coordinate the components implemented by other Operational Partners (Component 1,3,5).

The CTA, NPCs and UNESCO Technical Advisor and Technical Project Officers will oversee daily implementation, management, administration and technical supervision of the project, on behalf of the Operational partners and within the framework delineated by the PSC. They will be responsible, among others, for:

i) Overall technical lead for the implementation of all project outputs and activities and ensure technical soundness of project implementation;
ii) Coordination and close monitoring of the implementation of project activities;
iii) Coordination with relevant initiatives;

iv) Ensuring a high level of collaboration among participating institutions and organizations at the national and local levels;
v) Ensuring compliance with all Operational Partners Agreement (OPA) and the UN to UN agreement provisions respectively during the implementation, including on timely reporting and financial management;
vi) Tracking the project's progress and ensuring timely delivery of inputs and outputs;
vii) Providing technical support and assessing the outputs of the project national consultants hired with GEF funds, as well as the products generated in the implementation of the project, including knowledge management and communication outputs;
viii) Approving and managing requests for provision of financial resources using provided format in OPA annexes;
ix) Monitoring financial resources and accounting to ensure accuracy and reliability of financial reports;
x) Ensuring timely preparation and submission of requests for funds, financial and progress reports to FAO as per OPA reporting requirements;
xi) Maintaining documentation and evidence that describes the proper and prudent use of project resources as per OPA provisions, including making available this supporting documentation to FAO and designated auditors when requested;
xii) Implementing and managing the project's monitoring and communications plans;
xiii) Organizing project workshops and meetings to monitor progress and preparing the Annual Budget and Work Plan;
xiv) Submitting the six-monthly Project Progress Reports (PPRs) with the AWP/B to the PSC and FAO;
xv) Preparing the first draft of the Project Implementation Review (PIR);
xvi) Supporting the organization of the mid-term and final evaluations in close coordination with the FAO Budget Holder and the FAO Regional Evaluation Specialist under the guidance of FAO Independent Office of Evaluation (OED);
xvii) Submitting the OP required technical and financial reports to FAO and facilitate the information exchange between the OP and FAO, if needed;
xviii) Informing the PSC and FAO of any delays and difficulties as they arise during the implementation to ensure timely corrective measure and support.
xix) Providing draft terminal report for BH two months before the ending date of the OPA or the project;
xx) Leading and supervising the preparation of various technical outputs, e.g. knowledge products, reports and case studies;

FAO will be the GEF Implementing Agency (IA) for the Project, providing project cycle management and support services as established in the GEF Policy. As the GEF IA, FAO holds overall accountability and responsibility to the GEF for delivery of the results. In the IA role, FAO will utilize the GEF fees to deploy three different actors within the organization to support the project (see Annex J for details):

- The Budget Holder, the FAO Assistant Director General, Regional Office Asia and the Pacific (RAP), will provide oversight of day to day project execution;
- The Lead Technical Officer from FAO's Regional Office for Asia and the Pacific, in collaboration with experts drawn from across FAO will provide oversight/support to the projects technical work in coordination with government representatives participating in the Project Steering Committee;
- The Funding Liaison Officer(s) within FAO will provide oversight support the project cycle to ensure that the project is being carried out and reporting done in accordance with agreed standards and requirements.

FAO responsibilities, as GEF agency, will include:

- Administrate funds from GEF in accordance with the rules and procedures of FAO;
- Oversee project implementation in accordance with the project document, work plans, budgets, agreements with co-financiers, Operational Partners Agreement(s)and other rules and procedures of FAO;
- Provide technical guidance to ensure that appropriate technical quality is applied to all activities concerned;
- Conduct at least one supervision mission per year; and
- Report to the GEF Secretariat and Evaluation Office, through the annual Project Implementation Review, the Mid Term Review, the Terminal Evaluation and the Project Closure Report on project progress;
- Financial reporting to the GEF Trustee.

TORs of key staff and consultants to be hired by the project are included in Annex R: Terms of Reference of key staff and consultants.

IUCN's executing experience and capacity

IUCN has recent and ongoing experience and capacity to implement and execute GEF projects and transboundary dialogues in the Mekong Region.

1) In Myanmar, IUCN is the GEF Implementing Agency for the GEF 6 project 'Reversing Myanmar's forest degradation and deforestation and restoring forest landscapes through local multi-stakeholder co-management' 2019 and 2023. This is a child project of the GEF global project The Restoration Initiative (TRI) programme. The overall goal is to contribute to the restoration and maintenance of critical landscapes to provide global environmental benefits and enhanced resilient economic development and livelihoods, in support of the Bonn Challenge.

   Programme Components:
   Component 1. Policy Development and Integration
   Component 2. Implementation of Restoration Programs and Complementary Initiatives
   Component 3. Institutions, Finance, and Upscaling
   Component 4. Knowledge, Partnerships, Monitoring and Assessment
2) IUCN also serves as GEF IA for the regional peatlands project 'Sustainable Management of Peatland Ecosystems in Mekong Countries' 2019 and 2023. The project is being executed in the 3 countries of Myanmar, Cambodia, and Lao PDR. The Lao executing agencies include DWR and the LNMC in MONRE. The goal of the project is to sustainably manage peatland ecosystems in the target countries and to conserve biodiversity and reduce greenhouse gas (GHG) emissions, by:

   1. Expanding the network of protected peatland ecosystems in the countries in line with Aichi Target 11;
   2. Strengthening the capacity for sustainable peatland management at local, national and subregional levels; and
   3. Strengthening the management of peatland in existing protected areas to demonstrate sustainable management of peatland to conserve biodiversity, reduce GHG emissions and strengthen sustainable livelihoods for local communities.
4. IUCN has been designated as LOP for three GEF IW projects: 'Fostering Water and Environmental Security in the Ma and Neun/Ca Transboundary River Basins and Related Coastal Areas' between Viet Nam and Lao PDR; 'Promoting the Blue Economy of the Gulf of Thailand through the Ecosystem Approach to Fisheries' between Viet Nam, Cambodia, Thailand, and Malaysia; and the 'Bay of Bengal Large Marine Ecosystem'. FAO serves as IA for all three projects.

UNESCO's executing experience and capacity

UNESCO's Intergovernmental Hydrological Programme (IHP) is the only intergovernmental programme of the UN system devoted to the scientific, educational and capacity building aspects of hydrology. UNESCO has long recognized the importance of hydrology for the rational utilization of water resources. Since its inception in 1975, IHP has evolved from an internationally coordinated hydrological research programme into a comprehensive programme to facilitate education and capacity building, and enhance water resources management and governance. Originally implemented in six-year phases and now in eight-year phases since 2014, IHP stimulates and encourages hydrological research, and assists Member States in research and training activities. IHP facilitates an interdisciplinary and integrated approach to watershed and aquifer management, which incorporates the social dimension of water resources, and promotes and develops international research in hydrological and freshwater sciences.

UNESCO-IHP works to build the scientific knowledge base to help countries manage their water resources in a sustainable way through a global network that includes:

1. Affiliated research centers: 29 water-related research centers are working under the auspices of UNESCO on relevant thematic and geographic priorities in their areas of expertise. Four of these centers are focused on groundwater, namely the International Groundwater Resources Assessment Centre (UN-IGRAC) in Netherlands, the Regional Centre for groundwater management for Latin America and the Caribbean (CEREGAS) in Uruguay, Regional Centre for Shared Aquifer Resources Management (RCSARM) in Libya and the Regional Centre on Groundwater Resources Education, Training and Research in East Africa (RCGRE) in Kenya.
2. Water-related chairs: Chairs serve as think tanks and as bridge builders between academia, civil society, local communities, research and policymakers. Chairs are hosted at universities, and promote international inter-university cooperation and networking to enhance institutional capacities through knowledge sharing and collaborative work.
3. UNESCO- LASII (Land Sunsidence International Initiative). It involves scientisits from 15 counties (from all the continents) and have organized studies and international symposia on the topic since the mid-1980s. In this project the member from the University of Padova, Department of Civil, Environmental and Architectural Engineering (UP-DICEA), Italy, and the Wageningen University, Soil Geography and Landscape group (WU-SGLG), The Netherlands, will be specifically involved in the development of the dynamic modelling activities and training Cambodian and Vietnamese experts.

Groundwater related activities

Within UNESCO-IHP Secretariat, the Groundwater Systems and Settlements Section is responsible for groundwater-related activities. The work of the GSS section is articulated along 5 focal areas, listed below.

- Focal Area - Enhancing sustainable groundwater resources management
- Focal Area - Addressing strategies for Management of Aquifer Recharge (MAR)
- Focal Area - Adapting to the impacts of climate change on aquifer systems.
- Focal Area - Promoting groundwater quality protection
- Focal Area - Promoting management of transboundary aquifers

UNESCO-IHP has been involved as executing partner in the following GEF projects:

- DIKTAS I - GEF / UNDP (2010-2015): Development of Transboundary Diagnostic Analysis; Identify Baseline conditions, and environmental status indicators; establishing multi-country consultative body; adopt water resources and environmental quality targets; establish ad-hoc inter-ministerial committees.
- DIKTAS II - GEF / UNDP (2020-2025): Setting the basis of sound groundwater governance in the Dinaric Karst region. catalyze effective multi-country cooperation for the sustainable management of the Dinaric Karst Aquifer System and its ecological resources by strengthening national and regional groundwater governance frameworks and institutional capacity.

- Nubian - GEF / UNDP (2018-2022): Initiate regional SAP implementation through legal, policy and institutional reforms and addressing gaps identified in the SAP, supporting rational and equitable integrated management, socio-economic development and the protection of the ecosystem and resources of the NSAS in the four Nubian Countries
- Med I (Child Project 1.1) - GEF / UNEP/MAP (2010-2015): Assessing the risks to coastal aquifers and associated uncertainties, the preparation of subregional action plans, demonstrations in collaboration with ICZM, Integrated Water Resources Management (IWRM) and Marine Protected Areas and the identification of the legislative, policy and institutional reforms needed in 13 Mediterranean countries.
- Med II (Child Project 2.1) - GEF / UNEP/MAP (2020-2025): Operationalize priority actions to reduce major transboundary environmental stresses in its coastal areas while strengthening climate resilience and water security and improving the health and livelihoods of coastal populations of 9 Mediterranean countries.
- GWG (Groundwater Governance) - GEF/FAO/World Bank/IAH (2011-2014): First Phase: Review of the global situation of groundwater governance and aimed to develop a Global Groundwater Diagnostic integrating regional and country experiences with prospects for the future. Second Phase: develop a Global Framework for Action consisting of a set of policy and institutional guidelines, recommendations and best practices designed to improve groundwater management at country/local level, and groundwater governance at local, national and transboundary levels.
- Bug and Neman - GEF / UNDP (2019-2023): Improve and harmonize the countries' knowledge of the transboundary water resources, and of the expected impacts of increased climate variability and change. Facilitating the establishment of cooperation mechanisms and institutions among countries sharing the basins and their water resources. Testing of conjunctive surface and groundwater management approaches, through the application of the principles of eco-hydrogeology. Facilitating countries' commitment to joint priority actions. Communication, Dissemination and Replication Activities
- ITTAS GEF/UNEP – (2019-2023): The full-size project aims at improving knowledge-based management, governance and resources conservation of the Niger Basin and the Iullemeden-Taoudeni/Tanezrouft Aquifer System (ITTAS) to support Integrated Water Resources Managements (IWRM) for the benefit of communities and the resilience of ecosystems.
- TWAP - GEF / UNEP IGRAC (2012-2015): Assessing 199 transboundary aquifers and 43 Small Island Developing States. collect data and information management, while designing and development of software specifications for the TWAP Groundwater Information Management System. Co-organizing and presenting at regional workshops. Participation in the cross-cutting working groups on governance and data and information management.
- DRIN – GEF/UNDP, GWP-MED (2018-2020): Executing a pilot project with the aim to design and pilot test a modern multi-purpose transboundary groundwater monitoring network and related proposal of monitoring and data collection.

UNESCO World Water Assessment Programme (UNESCO-WWAP)

UNESCO World Water Assessment Programme aims at monitoring freshwater issues in order to provide recommendations, develop case studies, enhance assessment capacity at regional and national level, and inform decision-making processes. WWAP's primary product, the United Nations World Water Development Report (WWDR), is an annual and comprehensive review providing an authoritative picture of the state of the world's freshwater resources. Another WWAP's objective is to help bridge the gap in gender data and advance gender equality and women's empowerment. WWAP's methodology on the collection of sex-disaggregated water data with the use of gender-responsive indicators (UNESCO WWAP 2019 Toolkit on Sex-disaggregated Water Data), plays a significant role in overcoming the gender data gap.

The capacity development programme is designed to strengthen skills in collecting and analyzing sex-disaggregated water data to inform policy making, and water planning.
Related publications:
-Tool 1 'Gender-responsive indicators for water assessment, monitoring and reporting' features 105 gender-responsive indicators in 10 priority topics aligned with the 2030 Agenda (water governance; WASH; knowledge resources; transboundary water management; water for agriculture; water for industry and enterprise; human rights-based water resources management; water, migration, displacement, and climate change; indigenous knowledge and community water rights; water education and training).
-Tool 2 'Methodology for the collection of sex-disaggregated water data' describes the methodological approaches and concepts collecting good quality data.
-Tool 3 'Guidelines on the collection of sex-disaggregated water data' covers data collection methods for different users and different geographic regions.
-Tool 4 'Questionnaire for the collection of sex-disaggregated water data' lists 364 questions with instructions for developing surveys and interviews to collect qualitative and quantitative data in the field.

UNESCO-WWAP will be responsible for all gender activities, including gender analysis and action plan, working across all components to mainstream gender across all project activities.

MERFI's executing experience and capacity

MERFI, established in 2015, is specialised in transboundary water management and its leadership team draws their expertise from both global and international transboundary water management initiatives. MERFI and its staff have implemented and been involved in water-related projects across the region, including specifically in Cambodia, Viet Nam and with the MRC. MERFI was the first group in the world to conduct an applied Nexus assessment, which focused on hydropower development and the expansion of irrigation areas and involved a range of stakeholders from Cambodia and Viet Nam.

MERFI is also highly experienced in conducting visioning processes for transboundary water management and climate adaptation across the Asia Pacific. Over the past 15 years, it has implemented several visioning processes in Cambodia and Viet Nam with a wide range of stakeholders, including provincial and central government agencies, and non-government stakeholders. MERFI's mandate is not limited to policy focused research but has also a strong focus on capacity building.

MERFI implemented a number of participatory TDA-SAP type processes in Cambodia and Viet Nam involving many provincial and central government agencies. This includes the so-called MRC Council Study (2017-18), for which MERFI contributed the socio-economic, macro-economic, cumulative impact assessments, and advised the overall technical coordination of the multidisciplinary team. MERFI also conducted TDA-type assessments for various subbasins in the Mekong basin, including the Tonle Sap and parts of the Mekong Delta. More recently, MERFI developed an integrated assessment model for the MRC and the NMCs (2019-2020), the Mekong Region Simulation model (MerSim) that is focused on simulating the impact of alternative development trajectories informing a wide array of socio-economic indicators, which have been derived from the UN SDGs and contextualised for the Mekong basin during a participatory process with the NMCs.

6.b Coordination with other relevant GEF-financed projects and other initiatives.

The GEF IW project will be closely coordinated with the other GEF projects listed in the table below, through the knowledge exchange mechanisms proposed under section 8, as well as through periodic meetings between their respective implementation teams. This coordination will further be facilitated by the fact that many of the same national institutions are engaged in the different projects.

Coordination will focus on the following issues:

- Exchange of knowledge and results on ecosystem management options with potential for inclusion in pilots and for subsequent application and scaling out;

- Coordination of watershed management actions in order to optimize aquifer recharge potential;
- Consistency and complementarity with institutional capacity enhancement activities addressing shared institutional stakeholders;
- Consistency and complementarity with work on policy and planning processes with relevance to natural resources and groundwater management.

In regards to the coordination with non-GEF investments the PMU will work in Viet Nam primarily, but not exclusively, through the Mekong Delta Development Partners Working Group (MDWG) to share information and to coordinate the project with the baseline projects. IUCN is a founding member of the (MDWG) and an active member of the group. The MDWG is currently co-chaired by the World Bank and the Netherlands. As stated in its ToR, the stated objective of the MDWG is to " … enhance the coordination, complementarity and coherence of the efforts by the Government of Vietnam and Development Partners to improve the climate resilience of the Mekong Delta." (MDWG Terms of Reference, 17 Dec 2015).
In Cambodia, IUCN will seek to establish a similar development partners working group for the Cambodian Mekong Delta amongst development partners in Cambodia. The initiative is currently being discussed with the ADB.

GEF ID, funding source, implementing agency, title and status	Objective/summary
GEF ID 10177 (LDCF, FAO): Promoting Climate-Resilient Livelihoods in Rice-Based Communities in the Tonle Sap Region **(Cambodia)**. ***Under preparation.***	Rice based communities in the Tonle Sap region of Cambodia reduce their climate vulnerability and increase their resilience to climate change through an ecosystem based, market driven approach
GEF ID 9927 (GEFTF multi-focal, UNEP): Building Resilience of Cambodian Communities Using Natural Infrastructure and Promoting Diversified Livelihood (**Cambodia**). ***Under implementation.***	Addressing the challenges of water resources management as a contribution to the water, food, energy, ecosystem security nexus by restoring and protecting mangroves, making the business case for natural infrastructure in order to build resilience and improve livelihoods in the Prey Nob region (Cambodia)
GEF ID 4945 (GEFTF multi-focal, UNDP): Collaborative Management for Watershed and Ecosystem Service Protection and Rehabilitation in the Cardamom Mountains, Upper Prek Thnot River Basin **(Cambodia)** ***Under implementation***	To restore and maintain forest cover and watershed stability functions while providing for sustainable livelihoods and ecosystem services in the Upper Prek Thnot Watershed
GEF ID 9232 (GEFTF multi-focal, IUCN): Sustainable Management of Peatland Ecosystems in Mekong Countries **(Regional)** ***Under implementation.***	To sustainably manage peatland ecosystems in targeted countries and to conserve biodiversity and reduce GHG emissions
GEF ID 9265 (GEFTF multi-focal, World Bank): Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods Project **(Viet Nam)** ***Under implementation.***	To enhance tools for climate-smart planning and improve climate resilience of land and water management practices in selected provinces of the Mekong Delta in Viet Nam.
GEF ID 10245 (GEFTF multi-focal/FOLUR IP, FAO): Integrated Sustainable Landscape Management in the Mekong Delta **(Viet Nam)** ***Under preparation***	To support the transformation of rice-dominated landscapes in the Mekong Delta towards sustainable, adaptive and resilient models of production and landscape management that deliver multiple environmental and social benefits

7. Consistency with National Priorities.

Viet Nam's Government identified the Mekong Delta as the country's top priority as the challenges imposed by sea-level rise, land subsidence and salinity intrusion threaten the livelihoods of nearly 18 million people and the food security of the entire country. Two major development frameworks have been developed, the *Mekong Delta Plan* (2013) and the *Prime Minister Resolution 120* (2017). Both request government agencies (in particular MoNRE and MARD) to take immediate action to respond to aforementioned challenges. Since, the efforts of government agencies have found substantial support by international agencies.

The agricultural sector started undergoing a major restructuring in 2008 based on Resolution 26, which targeted increasing farm income, enhanced international competitiveness, and improved sustainability. The restructuring gave room for more diversity to adapt to the changing climatic and economic conditions, which involved a bigger variety in crops as well as sourcing farm income from aquaculture, in particular in coastal communities. The project will contribute to the resilience of the restructuring of rural livelihoods by providing robust evidence for groundwater dependencies and by designing management plans for sustainable groundwater use.

The project is also consistent with the Mekong Delta Integrated Regional Planning in period 2021-2030 and its vision to the year 2050 (MDIRP), which integrates a range of national priorities including freshwater fisheries, aquaculture and wetlands protection. The MDIRP constitutes the planning framework for Viet Nam's Mekong Delta. In regards to fisheries the MDIRP specifies that areas suitable for aquaculture will be prioritized for conversion to aquaculture, particularly focusing on the sustainable production of shrimp and pangasius. The MDIRP emphasizes the need to identify new aquaculture options to further diversify livelihoods and to promote biodiversity, and to limit extensive shrimp farming in coastal mangrove forests where it seriously affects the protection value and biodiversity and ecosystem of mangroves. The MDIRP highlights that the protection and regeneration of aquatic resources and restoration of habitats of native aquatic species is paramount. The MDIRP defines also critical strategies for wetlands as it requires local governments to restore biodiversity of terrestrial and aquatic ecosystems by establishing important wetlands and other areas of high biodiversity. The project will support the MDIRP's fisheries and wetlands focused strategies by assessing groundwater related implications.

Cambodia's Government defined water management, deforestation and fish stock management as three key priorities. Consequently, Government officials have requested this project to safeguard water availability for rural and urban communities, in particular against the backdrop of predicted climate change. The Ministry of Environment defines climate change and adaptation as the most critical issue (see "*Cambodia Climate Change Strategic Plan 2014-2023*") and expanding dry seasons are expected to introduce increasing concerns as upstream hydropower development continues to change hydraulic dynamics. From a food security perspective, Cambodia aims for substantial expansion of irrigated agricultural production (see MAFF's "*Agricultural Expansion Policy*", 2015), for which groundwater is considered a primary target due to the lack of water storage capacity and the perception that groundwater is entirely underutilized. To ensure efficient water uses and effective water management including groundwater in Cambodia, the "*Law on water resources management in Cambodia*" has come into force on 29 June 2007. Subsequently, 5 sub-decrees supporting the law of 2007 have been developed by MOWRAM to support the implementation of water law of 2007. However, groundwater levels have been dropping substantially, which has become a major concern for rural drinking water supply, which is highly dependent in groundwater (see MRD's "*National Strategy for Rural Water Supply*" 2011-2025). Recently, to promote safe water supply and sanitation, the national law on "*the water supply and sanitation regulatory law for Cambodia*" has been prepared. To mitigate water pollution of both surface and groundwater, MoWRAM has prepared and endorsed the Sub-decree #27 on Water Pollution Control since 1999. Recently, to protect, conserve and maintain groundwater resources in

Cambodia for sustainable long-term uses, MoWRAM developed the "*National strategy on groundwater* in Cambodia" and it is expected that this important document will be approved officially by the RGC in 2021. To reduce the degradation of environmental assets and the loss of important conservation zones in Cambodia, the Law on Environmental Protection and Natural Resource Management has been approved by the national assembly of Cambodia and has been published in 1996 by RGC.

The project will coordinate between the sector specific groundwater demands and provide decision makers and planners with the necessary evidence to design sustainable food production systems in Cambodia without compromising essential needs of other groundwater users. The project will moreover support countries in their efforts to meet the following SDG targets, including:

- *Target 6.4:* by 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity, and substantially reduce the number of people suffering from water scarcity
- *Target 6.5:* by 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate
- *Target 6.6:* by 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
- *Target 6.a*: by 2030, expand international cooperation and capacity-building support to developing countries in water and sanitation related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
- *Target 12.2:* by 2030, achieve sustainable management and efficient use of natural resources
- *Target 13.1*: strengthen resilience and adaptive capacity to climate related hazards and natural disasters in all countries
- *Target 13.2*: integrate climate change measures into national policies, strategies, and planning
- *Target13.3*: improve education, awareness raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning; and
- *Target 15.1*: by 2020, ensure conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wet- lands, mountains and drylands, in line with obligations under international agreements

In regards to fisheries focused policies the policy is fully supportive and consistent with Cambodia's priorities. The enactment of the 2006 Fisheries Law represented a positive step towards better fisheries management including the conservation of fish and their natural habitats. The new 125-article law replaces the outdated 1987 Fisheries Law. The 2006 Fisheries Law encourages the creation and proper maintenance of conservation area and promotes the development of aquaculture. It also aims to ensure long-term conservation and sustainable management of fishery resources taking into account social, economic and environmental factors.

The promotion of aquaculture is outlined in the National Aquaculture Development Strategy (NADS). The goal of NADS is a commercially viable and environmentally sustainable aquaculture sector contributing to food security and nutrition, socioeconomic development, GDP and export earnings. NADS strategies include the "increase access to sufficient and consistent supplies of high quality water, and to reduce flood risks" and to "maintain environmental quality", which are both aligned with the project's goals.

The strategic planning framework for fisheries (2015-2024) defines the better management of fish stocks and aquaculture as an overarching national priority. The earlier Strategic Planning Framework for Fisheries (2010-2019) was fully adopted by the Royal Government of Cambodia, and subsequently integrated into the "Rectangular Strategy" for Growth, Employment, Equity and Efficiency Phase III(RS III) and the National

Strategic Development Plan 2014-2018 (NSDP). Further, the Strategic Planning Framework for Fisheries is closely linked to the Agriculture Sector Strategic Development Plan (ASDP), of which the fisheries programme represents the National Fisheries Management Plan.

In regards to wetland management in Cambodia the National Protected Area Strategic Management Plan (NPASMP) 2017-2031 is the first comprehensive strategy document for protected areas in Cambodia and aims for improving the natioan's climate-resilience. Also relevant for wetland management is the Law on Environmental Protection and Management of Natural Resources (LEPMNR) (1996) influence the management of Cambodia's protected areas. The project is fully consistent with the NPASMP and the LEPMNR.

Furthermore, the project will consider where possible during conducting the TDA relevant indicators to inform and support the National Bio Strategy Action Plans (NBSAP), the CBD National Reports, the Cartagena Protocol National Reports, the Nagoya Protocol National Reports, the UNFCCC National Communications (NC), UNFCCC Biennial Update Reports (BUR), the UNFCCC National Determined Contributions, the UNFCCC Technology Needs Assessment, the UNCCD Reporting, the Stockholm National Implementation Plans (NIP) and NIP Updates, and the National Adaptation Programme of Action Updates. Several of these climate change adaptation and biodiversity focused initiatives will also be considered during the SAP and when designing demonstration projects to maximize synergies created by the proposed projects.

8. Knowledge Management.

The following main needs for knowledge management (KM) have been identified in relation to the project:

- Collection, organization of existing knowledge on biophysical, productive and socioeconomic conditions in the CMDA and related ecosystems, and its input into the formulation of the TDA.
- Organization, analysis and interpretation of knowledge generated through the proposed pilots, and its channeling in support of the development and subsequent application of the SAP.
- Channeling of knowledge generated through the proposed pilots to stakeholders, to allow their scaling out across the region in parallel with and beyond the process of SAP formulation.
- Monitoring of trends in conditions and of the effectiveness of management strategies in the CMDA and its related ecosystems, and management of the resulting knowledge in order to guide the adaptive formulation and implementation of the SAP.
- Sharing of knowledge on challenges, strategies and results related to the management of the CMDA and related ecosystems across the GEF IW portfolio.

In line with FAO's Knowledge Strategy (2011) and GEF's Knowledge management Approach (2015), these KM needs will be met through the following strategies:

1) Collaborative and participatory formulation of protocols for monitoring (including environmental quality indicators) and the processing, management and exchange of data;
2) The full engagement of institutional and local stakeholders in the formulation and management of pilots, in order to maximize their receptiveness to information on their results; and in the definition of indicators and design of corresponding monitoring protocols, in order to foment their adoption, application and sustained application;
3) Targeted capacity enhancement of key stakeholders (based on capacity needs assessment at project start), in order to raise their receptiveness and ability to receive, manage, digest and apply knowledge;

4) Engagement of national and regional academic and research institutions, in the collation and generation of knowledge, in its dissemination (through educational curricula and training events), and as repositories of knowledge generated through the project (in Viet Nam, advantage will also be taken of the Mekong Delta Centre, being established through the World Bank/MONRE ICRSL project, as a knowledge hub);
5) Regular knowledge outreach, through printed and on-line publications and periodic stocktaking and dissemination meetings;
6) Orientation on the format and content of the TDA and SAP in order to optimize their accessibility and utility to stakeholders as sources of relevant and applicable knowledge.
7) Contribution to GEF IW:LEARN and Kaleo resources
8) Participation in GEF IW:LEARN, including participation of project members and stakeholders in international conferences (https://iwlearn.net/events/conferences) and the preparation and sharing of experience notes (https://iwlearn.net/documents/experience-notes)

9. Monitoring and Evaluation.

The project will ensure transparency in the preparation, conduct, reporting and evaluation of its activities. This includes full disclosure of all non-confidential information, and consultation with major groups and representatives of local communities. The disclosure of information shall be ensured through posting on websites and dissemination of findings through knowledge products and events. Project reports will be broadly and freely shared, and findings and lessons learned made available.

- **Project oversight** will be carried out by the Project Steering Committee (PSC), and FAO (BH, supported by the PTF, LTO and FLO and relevant technical units in FAO headquarters as needed). Oversight will ensure that: (i) project outputs are produced in accordance with the project results framework leading to the achievement of project outcomes; (ii) project outcomes are leading to the achievement of the project objective; (iii) risks are continuously identified and monitored and appropriate mitigation strategies are applied; and (iv) agreed upon project global environmental benefits/adaptation benefits are being delivered. The FAO Project Task Force and FAO GEF Coordination Unit will provide oversight of GEF financed activities, outputs and outcomes largely through the annual Project Implementation Reports (PIRs), periodic backstopping and supervision missions.
- **Project monitoring** will be carried out by the PMU. Project performance will be monitored using the project results matrix, including indicators (baseline and targets) and annual work plans and budgets. A detailed M&E plan, which builds on the results matrix and defines specific requirements for each indicator (data collection methods, frequency, responsibilities for data collection and analysis, etc.) will also be developed during project inception by the M&E Consultant.
- **GEF Core Indicators:** The project will use the GEF7 core indicators and report against them during MTR and final evaluation.
- **Lessons learned and knowledge generation:** Results from the project will be disseminated within and beyond the project intervention area through existing information sharing networks and forums. The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks, which may be of benefit to the project. The project will identify, analyze and share lessons learned that might be beneficial to the design and implementation of similar projects and disseminate these lessons widely. There will be continuous information exchange between this project and other projects of similar focus in the same country, region and globally.

Project Monitoring and Evaluation Plan

Table 17 below summarises the project monitoring and evaluation pland and budget.

TABLE 17: MONITORING AND EVALUATION PLAN AND BUDGET

M&E Activity	Responsible Parties	Timeframe	GEF Budget (USD)
Inception Workshop	IUCN and FAO	Within two months of project document signature	Online
Project Progress Reports (PPRs)	IUCN and FAO	Bi-annually	M&E Specialist USD 180 000 full duration of project and travel USD 70 000
Project Implementation Review reports (PIRs)	IUCN and FAO	Annually in July	Covered by above
Independent Mid-term Review	FAO	In the 3rd quarter of the 2nd year of the project	USD 50 000
Independent Terminal Evaluation	FAO	To be launched within six months prior to the actual project completion date	USD 70 000
Terminal Report	FAO	Two months before the end date of the project	USD 6 550
Total Budget			**USD 376 550**

Specific reports that will be prepared under the M&E program are: (i) Project inception report; (ii) Annual Work Plan and Budget (AWP/B); (iii) Project Progress Reports (PPRs); (iv) annual Project Implementation Review (PIR); (v) Technical Reports; (vi) co-financing reports; and (vii) Terminal Report. In addition, assessment of the relevant GEF-7 Core Indicators against the baselines will be required at mid-term and final project evaluation.

i) **Project Inception Report.** The PMU will prepare a draft project inception report in consultation with the LTO, BH and other project partners. Elements of this report should be discussed during the project Inception Workshop, to be held in the 1st quarter of project year 1 (PY1) and the report subsequently finalized. The report will include a narrative on the institutional roles and responsibilities and coordinating action of project partners, progress to date on project establishment and start-up activities and an update of any changed external conditions that may affect project implementation. It will also include a detailed first year AWP/B and a draft M&E plan. The draft inception report will be circulated via e-mail to the PSC for review and comments before its finalization. The report should be cleared by the FAO BH, LTO and the FAO GEF Coordination Unit and uploaded in FAO's Field Program Management Information System (FPMIS) by the BH.

ii) **Results-based Annual Work Plan and Budget (AWP/B).** The draft of the first AWP/B will be prepared by the PMU in consultation with the FAO Project Task Force and reviewed at the project Inception Workshop. The Inception Workshop inputs will be incorporated and subsequently, the PMU will submit a final draft AWP/B to the BH within two weeks after the workshop. For subsequent AWP/B, the PMU will organize a project progress review and planning meeting for its progress review and adaptive management. Once PSC comments have been incorporated, the PMU will submit the AWP/B to the LTO for technical clearance, to the BH for non-objection, and the FAO GEF Coordination Unit for comments prior to uploading in FPMIS by the BH. The AWP/B must be linked to the project's Results Framework indicators to ensure that the project's work and activities are contributing to the achievement of the indicators. The AWP/B should include detailed activities to be implemented to achieve the project outputs and output targets and divided into

monthly timeframes and targets and milestone dates for output indicators to be achieved during the year. A detailed project budget for the activities to be implemented during the year should also be included together with all monitoring and supervision activities required during the year.

iii) **Project Progress Reports (PPR):** PPRs will be prepared by the PMU based on the systematic monitoring of output and outcome indicators identified in the project's Results Framework (Annex A1). The purpose of the PPR is to identify constraints, problems, or bottlenecks that impede timely implementation and to take appropriate remedial action in a timely manner. PPRs will also report on the project's risks and implementation of the risk mitigation plan. The Budget Holder has the responsibility of coordinating the preparation and finalization of the PPR, in consultation with the PMU and the Project Task Force (PTF) members. After LTO, BH, and FLO clearance, the FLO will ensure that project progress reports are uploaded in FPMIS in a timely manner.

iv) **Annual Project Implementation Review (PIR):** The PMU, in collaboration with the BH and the LTO, will prepare an annual PIR covering the period July of the previous year through June of the current year. The PIR needs to be submitted to the FAO GEF Coordination Unit Funding Liaison Officer (FLO) for review and approval no later than end of June/early July each year (the exact timelines for submission are communicated each year by the GEF Coordination Unit). The PMU will submit the first PIR draft to FAO BH/LTO, once finalized, the BH/LTO will submit it to the FAO GEF Coordination Unit as part of the Annual Monitoring Review report of the FAO-GEF portfolio. PIRs will be submitted to the GEF and uploaded on the FPMIS by the FAO GEF Coordination Unit.

v) **Technical Reports:** Technical reports will be prepared by national, international consultants (partner organizations under OPA and other Agreements) as part of project outputs and to document and share project outcomes and lessons learned. The drafts of any technical reports must be submitted by the PMU to the BH who will share it with the LTO. The LTO will be responsible for ensuring appropriate technical review and clearance of said report. The BH will upload the final cleared reports onto the FPMIS. Copies of the technical reports will be distributed to project partners and the Project Steering Committee as appropriate.

vi) **Co-financing Reports:** The BH, with support from the PMU, will be responsible for collecting the required information and reporting on co-financing as indicated in the Project Document/CEO Endorsement Request. The PMU will compile the information received from the executing partners and transmit it in a timely manner to the LTO and BH. The report, which covers the period 1 July through 30 June, is to be submitted on or before 31 July and will be incorporated into the annual PIR. The format and tables to report on co-financing can be found in the PIR.

vii) **Terminal Report:** Within two months before the end date of the project or the ending date of the project, the PMU will submit to the FAO BH and LTO a draft Terminal Report. The main purpose of the Terminal Report is to give guidance at ministerial or senior government level on the policy decisions required for the follow-up of the project, and to provide the donor with information on how the funds were utilized. The Terminal Report is accordingly a concise account of the main products, results, conclusions and recommendations of the project, without unnecessary background, narrative or technical details. The target readership consists of people who are not necessarily technical specialists but who need to understand the policy implications of technical findings and needs for ensuring sustainability of project results.

Evaluation Provisions

- The BH will arrange an independent Mid-Term Review (MTR) in consultation with the PSC, the PMU, the LTO and the FAO-GEF Coordination Unit. The MTR will be conducted to review progress and

effectiveness of implementation in terms of achieving project objective, outcomes and outputs. The MTE will allow mid-course corrective actions, if needed. The MTE will provide a systematic analysis of the information on project progress in the achievement of expected results against budget expenditures. It will refer to the Project Budget (see Annex A2) and the approved AWP/Bs. It will highlight replicable good practices and key issues faced during project implementation and will suggest mitigation actions to be discussed by the PSC, the LTO and FAO-GEF Coordination Unit.

- As per the FAO policy on evaluation, the FAO Office of Evaluation (OED) will conduct an independent Terminal Evaluation (TE) of the project, to be launched within six months prior to the actual completion date (NTE date). It will aim at identifying project outcomes, their sustainability and actual or potential impacts. It will also have the purpose of indicating future actions needed to assure continuity of the process developed through the project. FAO Office of Evaluation will conduct the evaluation in consultation with project stakeholders and the donor, and share with them the evaluation report, which is a public document.

  The evaluations will also assess how the OPA implementation and partnership agreement influenced the achievement and sustainability of results while contributing to enhance capacities of the OP(s). In doing so, the evaluation will consider the brief guidance note and evaluation questions OED has developed in consultation with the OPIM unit.

10. Benefits

Under the project model, the delivery of improved global environmental benefits (in terms of improved biophysical conditions in the aquifer and its associated ecosystems, some of which are of global importance for biodiversity) will be inextricably accompanied by social benefits including the following:

- Improved access to adequate water of acceptable biological and chemical quality, by the approximately 2.5 million people who depend directly or indirectly on the aquifer;
- Sustainably improved availability of water required for economic activities, including for irrigated agriculture and industry, resulting in enhanced productive, employment and livelihood support opportunities;
- Reductions in the effects of aquifer decline on wetlands, resulting from improved management of the CMDA, will help to safeguard the livelihoods of wetland-dependent communities, especially those dependent on the fisheries sector;
- Improved management of the CMDA will also help to reduce the exposure of the region's population to environmental risks, especially subsidence-related flooding and sea water incursion in Viet Nam's portion;
- The above benefits will in turn contribute to the sustainability of livelihoods and, consequently, to demographic stability, thereby helping to address the environment-related drivers of human migration that currently causing social and environmental impacts across the region.

PART III: ANNEXES

Annex A1: Project Results Framework

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible for data collection
Objective: To strengthen environmental sustainability and water security in the Lower Mekong Basin by investing, for the first time, in improved governance and sustainable utilization of the Cambodia-Mekong River Delta Transboundary Aquifer.							
Core indicator 7.1	TDA/SAP formulation and implementation	Level 1	Level 2	Level 4	Executing partners reporting	See project theory of change	PMU with inputs from all executing partners
Core indicator 7.2	Level of Regional Legal Agreements and regional Management Institutions to support its implementation	Level 1	Level 2	Level 4	Executing partners reporting		
Core indicator 7.3	Level of National/Local reforms and active participation of Inter-Ministerial Committee	Level 1	Level 2	Level 4	Executing partners reporting		
Core indicator 7.4	Level of engagement in IWLEARN through participation and delivery of key products	Level 1	Level 2	Level 4	Review of IW:Learn activities		
Core indicator 11	Direct beneficiaries	0	0	60 000 women 60 000 men 120 000 total	Executing partner reporting		
Component 1: Joint science-based diagnostic for groundwater dynamics (recharge and extraction) and effects on ecosystems (e.g. fish, wetlands) and livelihoods							

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible for data collection
Outcome 1: Consensus among countries on key transboundary and national concerns affecting the aquifer, reached through joint fact finding, opening pathways to concerted remedial actions.	*TDA and the Environmental Status Indicators (ESI) endorsed by the countryies'representatives in the Steering Committee.*	*Knowledge on the TBA is uneven between the countries and transboundary implicatiions have not been assessed nor agreed upon.*	*Finalization of the assessment of the aquifer's water resources current state and projected scenarios, as well as of the evaluation of dependent ecosystems.*	*TDA with corresponding Environmental Status Indicators submitted for endorsement to the Steering Committee.*	*Minutes of the relevant SC meeting approving TDA*	*Effective and inclusive involvement by target stakeholders, local communities and the inhabitants of the aquifer area reached throughout project implementation*	*National executing partners and Joint Technical Committee*
Output.1.1 Assessment of current state of groundwater resources, recharge and extraction dynamics.	Assessment report submitted for SC approval F/M participation of officials from relevant ministries and institutions in the Assessment Team	Only fragmented and sectoral sets of data exist so far.	Assessment report cleared by the JTC. Availability of a state of the art model of the aquifer system allowing to quantitatively predict the evolution of piezometric head, and land subsidence in spaced and time.	Assessment reports cleared by the PMU.	*Minutes of the relevant SC meeting approving the Assessment report*	Effective support from national sciencits, local communities, other stakeholders and administrative bodies	National executing partners and Joint Technical Committees
Output 1.2 Analysis of groundwater related dependencies of related ecosystems	Reports on groundwater dependent ecosystems submitted for PMU approval. Gender and ethnic minority considerations included in the reports on the groundwater	Ecosystems in both basins threatened by unsustainable groundwater management.	One report on ecosystems depending on groundwater in the Cambodia-Mekong Delta aquifer.	One report cleared by the PMU.			

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible for data collection
	related dependencies of related ecosystems.						
Output 1.3 Agreed upon Transboundary Diagnostic Analysis (TDA), including assessment of related governance, socio-economic, legal and gender aspects.	TDA, including considerations of gender equality aspects and the use of disaggregated data, endorsed by the countries'representatives in the Steering Committee. Participation by F/M (female/male) members in the Steering Committee.	Lack of consideration of transboundary groundwater management and aquifer recharge strategies.	TDA cleared by Joint Technical Committee	TDA cleared by PMU	TDA submitted to the SC for approval		
Output 1.4 Agreement reached on Environmental Status Indicators.	ESI technically cleared by the SC, and submitted for adoption by the relevant authorities in the two countries. Number of participatory consultation meetings with men and women from rural communities, including representatives of IP communities and private sectors.	Environmental indicators are novel to the region	Joint Technical Committee prepares proposal for ESI	Report presenting sets of indicators for the aquifer	Minutes of the relevant SC meeting	Sustained political support to the TDA process	Joint Technical Committee

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible for data collection
Component 2: Piloting solutions for improved transboundary groundwater management							
Outcome 2. Tested strategies for improved groundwater recharge, reduced extraction and mitigated ecosystem/ livelihoods trade-offs.	Demonstration project designs, implementation reports, and upscaling-focused assessments for at least three demonstration projects for improved groundwater management (extraction and recharge) in each country. Demonstration projects include disaggregated data by gender and ethnic minority.	*Transboundary aquifer manaement and aquifer recharge strategies and practices that the project will test on the ground are new to the region.*	*Demonstration projects under implementation.*	*At least 2 demonstration projects implemented in each country.*	*Final reports of demonstration projects.*	*Countries reach consensus on the typology and location of the demonstration projects during the first year of the project implementation.*	*JTC and Country Execution Teams*
Output 2.1 Pilot demonstrations of innovative groundwater management and utilization after adequate feasibility studies	Agreement on the selection and design of the pilot demonstrations reached including procedures for gender balance participation. Participation of members of local communities and relevant stakeholders identified by gender, locality and ethnicity in the design and selection of pilot projects.			The program and the design of the demonstration projects approved by the SC.	Minutes of the relevant SC meeting.		
Component 3: Transboundary cooperation mechanisms							

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible for data collection
Outcome 3. Agreed improvements of transboundary cooperation improve aquifer transboundary governance.	Agreement on the creation of a Bilateral coordination and consultation body (TCCB) signed by two countries. Procedures for gender balanced participation in the TCCB including ethnic minority balance	*Neither country recognizes transboundary implications of aquifer management.*	*Design and TORs of new cooperation mechanisms prepared by the Joint Technical Committee.*	*Shared vision and design of new permanent cooperation frameworks and mechanisms submitted for clearance to the SC*	*Minutes of the relevant SC meeting*	*Sustained political support to establishing transboundary cooperation frameworks.*	*National Executing Partners, Joint Technical Committee and the PMU*
Output 3.1 Harmonized design of groundwater monitoring networks and protocols	Design of a harmonized and optimised monitoring network covering groundwater extraction and recharge, land subsidence, and their dependent ecosystems – prepared by the relevant JTC. Participation by F/M (female/male) within networks and protocols, including representatives of ethnic minorities	Monitoring is so far sporadic and lacks transboundary harmonization.	Draft design of monitoring networks ready for first review by governments.	Commonly agreed and developed by the JTC monitoring design submitted to the SC for approval.	Minutes of the relevant SC meeting	Countries willing to jointly coordinate monitoring network on status of groundwater resources.	JTC and the PMU
Output 3.2 Agreement on groundwater data exchange mechanisms and procedures.	One data exchange mechanism designed and agreed by both countries.	No data sharing agreement exists for groundwater resources.	Draft design of data sharing protocols ready for first review by governments.	Commonly agreed and developed by the JTC data sharing protocols submitted to the SC for approval.	Minutes of the relevant SC meeting.	Countries willing to share data on status of groundwater resources.	JTC and the PMU
Output 3.3 Design of permanent transboundary consultation and coordination body (TCCB)	The TOR of the TCCB and of the Secretariat, including its modus operandi and balanced gender representation approved by governments, and TCCB established.	No transboundary consultationand coordination body exists for the target aquifer. Some	Draft TOR of the TCCB technically cleared by the SC.	The TOR of the TCCB submitted to governments for approval	Documentation proving submission	Sustained political support for transboundary cooperation	JTC and the PMU

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible for data collection
	Participation by F/M members in the TCCB, including in the leadership positions.	issues are partially coordiated through the MRC from a broader lower Mekong basin persepctive.					
Component 4: Joint strategies and action programs							
Outcome 4 Commitment reached among countries on implementing priority legal, institutional and policy reforms and investments for the protection and equitable utilization of the shared aquifer and its' dependent ecosystem.	SAP approved/signed by the relevant Minister(s) in each country.	Countries' actions lack strategic vison and transboundary coordination	SAP being drafted based on TDA findings and shared Vision	SAP submitted for signature by at least one Minister in each country	Documentation proving submission.	Project development strengthens political commitment to transboundary cooperation	TCCB, IMC, JTC and PMU
Output 4.1 Countries establish Joint Technical Committees (JTCs) and ad hoc inter-ministerial committees (IMCs).	Regional gender and ethnic minority balanced JTCs established and operational. IMCs established in each country, and operational.	Lack of consideration in countries' planning of the water-food-energy-ecosystyems nexus.	JTCs and IMCs established.	JTCs and IMCs actively engaged in the drafting of SAP.	Minutes of JTCs and IMCs meetings.		TCCB, country execution teams, and PMU.
Output 4.2 A shared long-term Vision (horizon 20 years) including the agreement on environmental quality targets.	Number of long term Vision and EQ targets for the transboundary aquifer and dependent ecosystems. Gender equality indicators and ethnic minority concerns	Countries' plans and development strategies relevant for the transboundary aquifer lack harmonizaton	Two long term visions and corresponding EQ targets submitted to the SC for approval.	One vision and corresponding EQ targets inform the SAP.	Minutes of the relevant SC meeting.	Enduring political commitment to the cooperation process.	JTC and the PMU.

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible for data collection
	included in the shared long-term vision.	and common targets.					
Output 4.3 Strategic Action Program (SAP) with horizon of 5 years, consistent with the Shared Vision.	SAP, including reforms and investments, and incorporating the Gender Action Plan (5.3) completed. Ethnic and gender-responsive indicators for programme and project design, and legal frameworks.	Lack of joint strategies for transboundary aquifer management.	SAP being drafted based on TDA findings and shared Vision.	SAP submitted for signature at Minister level.	Documentation proving submission	*Project development strengthens political commitment to transboundary cooperation.*	TCCB, IMCs, JTC and the PMU.
Component 5: Reinforced institutional capacity, improved participation, gender mainstreaming, monitoring and coordination.							
Outcome 5.1 Implementation of project mechanisms for monitoring, improved stakeholder consultation, gender mainstreaming, dissemination, coordination and monitoring progress enhance long-term sustainability of achievements.	Skills and knowledge on transboundary issues of 100 gender-balanced national staff increased by 50 percent over baseline levels. Number of staff by gender, locality and age in capacity development activities and stakeholders engagement events. Guidelines on gender and ethnicity integration into TBA.	*Land and water administrators relevant for groundwater extraction and recharge lack experience in transboundary aspects.*		*At least 100 land/water adminsitrators received training and attended SMs.*	*Report of training activities, and SM minutes.* *Written guidelines on gender and ethnicity integration into TBA*	*Project management able to raise interest of targeted groups*	*PMU*
Output 5.1 Structured capacity building in groundwater governance for decision makers and other stakeholders.	Number of training courses held during the project lifetime. Number of trained experts (F/M) from Cambodia and Vietnam in dynamic modelling Number of trainees by gender, locality and age.		5 courses held 2 experts trained in dynamic modelling At least 50 trainees	10 courses held 2 experts trained in dynamic modelling At least 100 trainees	Modules and reports of training courses.		PMU

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible for data collection
Output 5.2 Annual stocktaking and awareness raising meetings with relevant stakeholders (e.g. local, national and regional meetings).	Number of Stocktaking Meetings (SM). Participation by F/M of relevant stakeholders with balanced representation by locality and ethnicity.	N/A	2 SMs held	4 SMs held	SMs report		PMU
Output 5.3 Water and Gender Action Plans and indicators, based on results of Component 1, adopted by relevant authorities in both countries.	Water and Gender Action Plans and indicators completed. Gender-responsive Monitoring and Evaluation (M&E) system using data disaggregated by sex, age and etchnicity.	Lack of Water and Gender Action Plans and indicators for transboundary groundwater management.	At least one Water and Gender Action Plan with set of indicators being drafted based on results of Component 1, and budgeted.	Water and Gender Action Plan with set of indicators submitted for signature at Minister level. Gender-responsive Monitoring and Evaluation (M&E) system in place.	Water and Gender Action Plan with set of indicators documents published, that will be integrated in the projects accountability /logframe.		*TCCB, PMU*
Output 5.4 Periodic events for the coordination with other ongoing initiatives organized by the PMU/TCCB.	*Number of dissemination events and experience notes / documents / videos including on gender activities.* Coordination mechanisms with relevant national and international stakeholders implementing NRM, water and agricultural fisheries activities.	N/A	*5 events* *10 documents* *1 video*	*10 events* *30 documents* *2 videos*	*Project website including a TBA Gender and Ethnicity on-line resource library*		*PMU, JTCs*
Output 5.5 Full participation to GEF IW LEARN activities, creation of a project website, and preparation of experience notes.							

Annex A2: Project Budget

The Excel file contains

- Results-based budget template for a GEF project
- Guidance notes for the development of a GEF project's results-based budget

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Annex B: Response to Project Reviews

(from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion, and responses to comments from the Convention Secretariat and STAP at PIF).

STAP Review comments	Responses
STAP welcomes the project from FAO entitled "Enhancing sustainability of the Transboundary Cambodia - Mekong River Delta Aquifer." The project fills an important gap, with past programming focused primarily on surface flows.	Thank you, much appreciated
Intervention logic is well summarized visually in Figure 1. The project would benefit, however, from identification of barriers to achieving objectives at scale, particularly given the fraught political history between the two countries. There is clear scaling intent, but mechanisms for scaling beyond the target aquifer need elaboration. Outcomes are largely dependent upon the quality of stakeholder engagement processes.	Barriers and challenges have been identified and discussed on pages 29-31.
Omission of international CSOs among stakeholders contributing technical expertise to design appears to be an important gap.	CSOs have been involves during the project preparation phase and will be part of the execution team (IUCN and MERFI).
Gender equality importance is noted, but treatment is minimal.	An extensive gender assessment has been conducted during the project preparation phase, see see Output 5.3 and Annex N2.
Description of KM plans are very high-level. Both would benefit from identification and elaboration of specific mechanisms to address anticipated barriers.	The description of the project's KM approach has been expanded, see pages 107-108.
Additional baseline data on the aquifer is required, but this is part of the investment.	The project preparation phase developed an extensive sector assessment, which builds a solid foundation for the TDA, see Annex M1-M4.
Intervention logic well summarized visually in Figure 1. Would, however, benefit from identification of barriers to achieving objectives at scale, particularly given the fraught political history.	Barriers and challenges have been identified and discussed on pages 29-31.
Clear scaling intent, but mechanisms for scaling beyond the target aquifer need elaboration.	Details have been added with specific examples, see page 74.
Relevant ministries and agencies appear well covered; identification of national CSOs appears very preliminary; international CSOs are included as a category but not named. Omission of international CSOs among stakeholders contributing technical expertise to design appears to be an important gap. Conservation International and IUCN, among others, are undertaking highly relevant work.	The project engaged with a few international NGOs and in particular with IUCN. IUCN was then also selected to become the lead execution agency.

Gender equality importance is noted, but treatment is minimal. Notes relevant policies and potential areas of attention. More specific identification of barriers and approaches to address these should be undertaken.	An extensive gender assessment has been conducted during the project preparation phase, see see Output 5.3 and Annex N2.
Good identification of relevant investments, and appropriate potential focus of learning exchange identified for proposed FOLUR project in Vietnam. Would benefit from similar identification of learning potential from the wide variety of other projects.	Details for learning exchange and collaboration with other projects have been added on page 105.
Is there adequate recognition of previous projects and the learning derived from them? Specific lessons of prior projects not well specified. Have specific lessons learned from previous projects been cited? Given consultations this is likely, but these should be better specified.	Details on prior projects have been substantially expanded on, including lessons learnt, see Pages 43-55.
Is there an adequate mechanism to feed the lessons learned from earlier projects into this project, and to share lessons learned from it into future projects? Mechanisms for harvesting and sharing of lessons is presumably a part of the periodic consultations planned; but the mechanisms should be spelled out.	This has been made explicit as part of outputs 5.2 and 5.4.
Description of KM plans are very high-level. Would benefit from elaboration of specific mechanisms, including approaches to monitoring and evaluating the outcomes of past efforts, generating lessons and sharing these through diverse communication channels, targeted (in language and accessibility) to key influencer groups.	The description of the project's KM approach has been expanded, see pages 107-108.

GEF Secretariat	**Responses**
The project is aligned with the GEF IW focal area objective 3 - water security. Please consider a split of the IW resources across the three subobjectives (3.5 information; 3-6 institutions; and 3-7 investments (incl. pilots)).	A new split has been adopted in Table A as follows: 3-5: 4 500 000 3-6: 5 950 000 3-7: 4 550 000
Please include a component or subcomponent on M&E activities (as part of the project execution).	Monitoring now appears in Component 5 (page 3 and 18)
Component 2 should be labelled as investments (pilots) not TA	Component 2 now labelled as investments
Please explain the use of the category "Public Investment"	The category Public Investment was used because these investments are new investments under Vietnam's upcoming five-year development plan and in Cambodia from recently started investments.

Please make sure that at endorsement, MTR and TER there is transparent alignment of co-finance and components.	FAO will continue to ensure the transparent alignment of co-finance with components at endorsement.
Please confirm that the World Bank ICRSL co-finance and is new and additional and not already counted as co-finance towards the WB GEF 6 Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods project (GEF ID 9265) which was recently endorsed.	In consultation with Viet Nam and the World Bank, the ICRSL project has been replaced with government investment from MARD in Viet Nam.
- You may want to explore possible co-finance with the BGR efforts on groundwater/groundwater quality at selected sites of the delta.	Co-finance with BGR was explored, and given the high investment of the Vietnamese government already secured we decided to not specifically list the BGR investment. However we will continue to coordinate with this important initiative.
Please revise the entry in table C and put "regional" or "regional (Cambodia, Viet Nam)" instead of only one of the countries.	GEF fInancing in table D is listed as “Regional”.
Please reevaluate the total number of people DIRECTLY benefiting from project (physical) interventions. The number of >20 million by that definition is way to high; please revise.	Done – Direct beneficiaries would be the population in districts where pilot projects will be implemented during the project and where new institutional arrangements (e.g. transboundary aquifer management plan) will create immediate benefits (e.g. wetland protection, productivity improvements). This is likely to benefit at least 10 percent of the population (e.g. coastal districts, groundwater dependent agriculture), or 2.5 million people. Indirectly, due to the positive impacts effective transboundary aquifer management has, a large part of the entire population dependent on the Mekong Delta aquifer (~25 million people) will benefit as water security will be enhanced and land subsidence rates will slow down.
Please fill the Rio Marker on Adaptation.	Done
Please note that the GEF project connected to ICRSL , the *Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods project* (GEF ID 9265) which is listed as *planned in table 1*has recently been endorsed. By *endorsement*, please complete the picture incl. the few missing entries on implementation period and investment amounts.	The GEF-funded ICRSL project is now listed in Table 1 under “current projects”.
The alternative overall is well described at concept/PIF stage and has responded to upstream discussions and suggestions with GEFSEC. Suggest to restate the PDO in the first para. Also, the first para under the heading of the *GEF alternative* misses to recap briefly what	PDO is now restated as suggested.

is described in detail in the justification, namely WHY there is a need for transboundary cooperation and why it is necessary to look at the entire aquifer across both countries in order to sustain both recharge and sustainability of ecosystems and their functions and aquifer uses in both countries. It would be useful to state this briefly upfront (~one sentence).	
- Table 2 is good and meant to show both what is already happening and then the gaps that this project will fill (blank boxes; BTW shading them would make that even more clear). For the ongoing projects, please indicate which are only in Viet Nam and/or Cambodia.	We added in Table 2 the location of the various investments (VN and/or CA)
Component 1: The typical TDA is built on existing/readily available data. In this case this is different and the component will field a number of assessments (listed under points (i) to (vii)) on which the TDA will build on and also justifying the funds (4.5 million of the GEF grant plus co-finance) going into this. As some of these studies/assessments listed under the points mentioned are substantive outputs , please list the main ones (not necessarily all under (i) to (vii)) as outputs under this component in addition to the TDA.	Component 1 The main studies/assessments are now listed.
Component 2: While this is at concept stage, it would be useful to provide an indicative/rough number of pilots (number of investment or expected/indicative range of USD investments)	Component 2 Approximately 2-3 pilots per country is now indicated.
Component 4: Environmental quality targets – please ensure that these include quantifiable targets and not simple statements/targets to "improve…", "enhance…" etc. Please, include some *examples* of such status indicators in the PIF and, by endorsement, include some additional guidance and wording to that effect (i.e. on the need to include quantitative targets). Please note in the PIF that the SAP is to be endorsed and signed by a Minister from each country (i.e. the SAP includes a commitment to actions by countries and hence needs more than only technical level endorsement)	Component 4 Examples of status indicators have been added on page 18: "(e.g. groundwater level, land subsidence rate, groundwater recharge target, groundwater extraction quota)" Ministerial level sign-off is now clearly indicated
By endorsement, please refer to the IW:Learn TDA and SAP guidance which e.g. provides	Noted on the need to refer to IW:LEARN guidance at endorsement

guidance to include local academe and civil society organizations in the TDA process; same for private sector to be involved in the discussions on the TDA and SAP. The private sector will be important in the successful implementation of SAP actions (both following enhanced regulatory measures, finance and investments).	
Please expand the clarity of the incremental cost analysis. The para should outline how/why the regional increment leads to much larger benefits/GEBs than current national approaches.	More explanation has been added to Section 5 explaining that national interests are currently being pursued in a way that is unsustainable for both countries, and a regional approach will help to quantify potential impacts and take full advantage of collaborative efforts to manage the shared resource.
You may want to be careful in the use of using the wording of promoting "appropriate allocation" Please further develop the description of expected GEBs (e.g. drawing from what is already described in the PIF in the *project description* and the section *global environmental problems to be addressed;* Global environmental benefits and co-benefits could include contribution to sustaining fish habitats and migration, sustainability of food systems, and ecosystems functions). The current discussion of GEBs is more focused on process than GEB outcome.	The wording around allocation has been amended, using 'jointly agreed' allocation Examples of the GEBs are given including water security enhancements, improved resilience of groundwater dependent ecosystems (e.g. wetlands, fish abundance and diversity); and sustainable food production systems
Under innovation, you may want to mention that any functioning transboundary aquifer cooperation mechanism is innovative given there are only a handful of those around the globe. Further, the elucidation of intersectoral interdependencies on groundwater uses and dependency of low flows, coastal flows, sustainability of food systems, wetlands and their functions, and fish habitats etc. on sustainable groundwater uses and improved governance of the resource (both quality and quantity) is still new and innovative not only in the region but globally.	This is now revised.
The first para has little to do with the project (?) e.g. mentions the role of women in fisheries post-harvest activities and the fisheries value chain. True but hard to relate to the main actions of the project.	Amended.

Gender actions listed in the bullet points are generally well described. There is mention of strengthening women's participation in decision making. During project design and implementation please also assure gender consideration in the design of all project components and especially participation in and access to resources and benefits from pilots.	
While the project justification outlines the climate risks and relevance of the project in increasing resilience, the risk section/table is silent on climate risks. Please summarize key risks and project mitigating actions in responding to these.	Climate risk screening has now been conducted and is included in the PIF.
Please also explicitly include coordination with the GEF 6 (now endorsed) Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods project (GEF ID 9265) and the co-finance ICRSL in project design and implementation.	Done – close coordination with this project is planned (but not as project co-finance)
Please provide short outlines (short para) of key national sectoral policies, strategies and MEA related action plans for both countries as relevant and refer to alignment of the project with these and/or how the project will inform revision processes .	We added food security related policies, which involve livelihood diversification and increased environmental sustainability. We already listed the main policies relevant for the Mekong Delta area and for Cambodia from a sector perspective. We also added how this project aims to support these policies, which involves improved water security for the new livelihood diversification strategies and for increased farm income.
By endorsement, please allocate at least 1 percent of the GEF grant to IW:Learn related activities incl. participation in IWCs and regional and thematic meetings.	Noted, and will be taken into account by endorsement.
COUNCIL COMMENTS BY COUNTRIES	

France - comments	**Response**
This project aims to increase knowledge of the transboundary Mekong basin and strengthen cooperation between Vietnam and Cambodia. Is the Mekong River Commission, the international commission tasked with promoting and coordinating assistance for the management and use of water (from the Mekong basin), involved in all or a portion of this project?	Yes, the MRC is involved. As this is a bilateral project the mandate lies with the National Mekong Committees (NMCs) in Cambodia and Viet Nam. Both will have a central role during the SAP process, incl. coordinating and chairing all TDA-SAP workshops. The NMCs will also invite the MRCS to attend these workshops.
Do the project's five components ("(i) strengthening transboundary cooperation including joint fact finding and information exchange; (ii) enhancing groundwater recharge; (iii) supporting innovative solutions to optimize groundwater use, reverse salinization trends and increase resilience to climate change; (iv) reducing	The project will include a range of institutional elements as part of components 3 and 4, including the stablishment of a transboundary consultation and coordination body for the management of the aquifer and the establishment of a joint technical committee,

agri-pollutants contamination of ground and surface waters; (v) and contributing to protecting groundwater dependent ecosystems") include an institutional approach or are they limited to a technical one?	
Does the project make provision for consideration of the type of water uses? One of the areas of focus covers the reduction of agricultural pollution (qualitative aspect); a broader consideration of the type of needs and withdrawals would also pave the way to address the quantitative aspect.	The project will focus on both, the quantitative and the qualitative aspect of groundwater use (and recharge) and will not be limited to agricultural activities. Ultimately, water quantity will be most critical to manage land subsidence.
Germany - comments	**Response**
Germany requests taking into account that transboundary dynamics in the grand aquifer system in the Mekong Delta are marginal and that cross-border flows between Cambodia and Viet Nam only constitute a minor element in the groundwater balance of the Vietnamese delta. Local surface interactions like recharge through rain and rivers, as well as abstraction of groundwater through pumping have a far greater impact than cross-border flows.	This will be taken into account and the TDA will specify how marginal the connecting cross-border flows are.
Germany acknowledges the importance of surface-groundwater interactions as described in the PIF. Germany would prefer consequently including investigations into surface-groundwater interactions addressing aspects of recharge and discharge dynamics as well as groundwater demand as project components	Groundwater recharge will be a very important aspect of developing a transboundary aquifer management plan. It has been emphasises as part of the TDA (Outputs 1.1, 1.2 and 1.3), the design of pilots (Ouput 2.1) and the SAP process (Outputs 3.1, 3.2, and 4.3). Water demand is equally a critical aspect of aforementioned outputs and their underpinning activities.
Germany suggests assessing the hydrogeological settings locally in the border region as useful joint activities that can establish the baseline for further coordinated governance of groundwater between Cambodia and Viet Nam in the border region. Germany suggests the following addition to the project's outputs: Output 1.1: Assessment of current state of Groundwater resources, recharge and extraction dynamics, "analysis of surface-groundwater interactions and the extent of connectivity across borders."	The countries are expecting a wider assessment of groundwater resources, which means that we met resistance to change the title of the output. However. we added to the compoment description the following: "These assessments will include the analysis of surface-groundwater interactions and the extent of connectivity across borders." (p.60)
Germany is of the opinion that the limited availability of hydrogeological data for the Cambodian side of the aquifer should be addressed by the project.	We fully agree and the monitoring equipment that will be put in place (based on an agreed data sharing agreement) will improve the future groundwater data availability in Cambodia.
Germany proposes carrying out feasibility studies on managed aquifer recharge for the specific regions. - Germany suggests adding the following aspects to the project's outputs: Output 2.1: Pilot demonstrations of innovative groundwater management and utilization "after adequate feasibility studies."	Thanks, we made the suggested change.

Germany would appreciate it if existing regional organisations like the Mekong River Commission (MRC) could be considered as regional partner organisations for data sharing, and to avoid the creation of redundant bilateral bodies and duplication of water management plans.	Yes, the MRC is involved. As this is a bilateral project the mandate lies with the National Mekong Committees (NMCs) in Cambodia and Viet Nam. Both will have a central role during the SAP process, incl. coordinating and chairing all TDA-SAP workshops. The NMCs will also invite the MRCS to attend these workshops.
- Germany suggests adding the following aspects to the project's outcomes: Outcome 3: Agreed upon arrangements for transboundary cooperation "embedded in existing transboundary mechanisms and organisations."	Currently there is no transboundary mechanism for groundwater management in place. In consultation with the countries and relevant stakeholders, the suggested addition cannot be implemented.
Germany would prefer it if the project could account for the risk that improved irrigation systems and advocacy for groundwater use, as potentially through co-financed projects listed in this proposal, might increase groundwater abstraction rates. Germany further suggests working towards improved groundwater management policies and licensing as a management tool to address these developments.	We fully agree with this point, which is why these investments (e.g. irrigation expansion in Cambodia) are listed forongoing coordination and exchange. The ultimate goal of this project is a trasboundary action plan, and the revision of policies to improve the sustainability of the CMDA.
Germany would like to extend an invitation for consultation with the German BGR.	The BGR work is an important initiative in Viet Nam's Mekong Delta and this project lists the BGR work as a baseline project. Consultation will be coordinated as part of various components, incl. 1.1 and 5.4.

Annex C: Status of Utilization of Project Preparation Grant (PPG)

PPG Grant Approved at PIF: **USD 300 000**			
Project Preparation Activities Implemented	***GETF/LDCF/SCCF Amount (USD)***		
	Budgeted Amount	***Amount Spent To date***	***Amount Committed***
Consultant	159 400	157 161	2 239
Contracts	30 700	20 199	10 501
Administrative support and liaison with country counterpart	10 000	4 893	5 107
Meeting organization material and communication	2 100	2 079	21
Training	62 800	7 856	54 944
Travel	35 000	9 275	25 725
Total	**300 000**	**201 463**	**98 537**

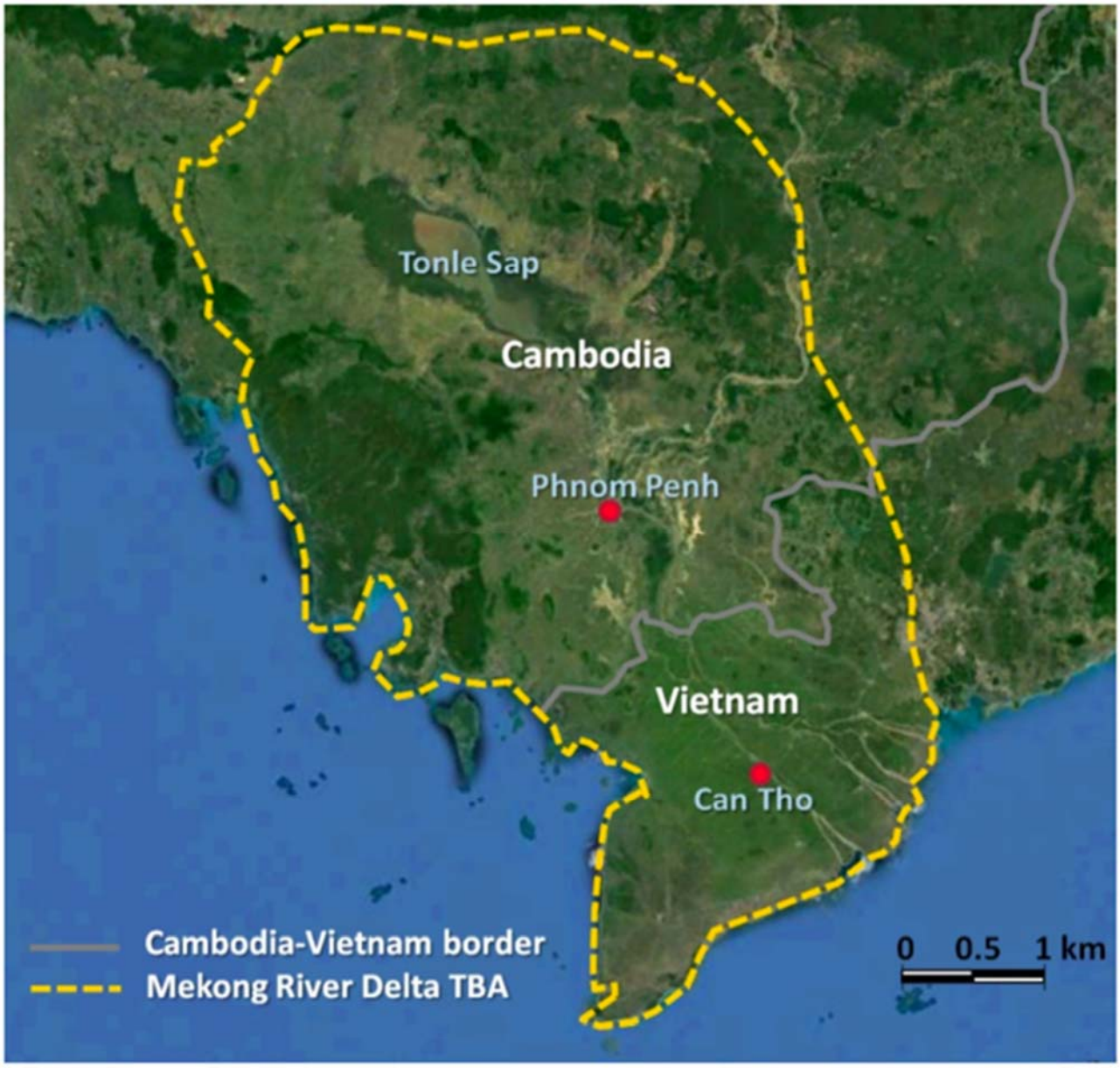
If at CEO Endorsement, the PPG activities have not been completed and there is a balance of unspent fund, Agencies can continue to undertake exclusively preparation activities (including workshops and finalization of baseline, when needed) up to one year of CEO Endorsement/approval date. No later than one year from CEO endorsement/approval date. Agencies should report closing of PPG to Trustee in its Quarterly Report.

Annex D: Calendar of Expected Reflows (if non-grant instrument is used)

Provide a calendar of expected reflows to the GEF/LDCF/SCCF Trust Funds or to your Agency (and/or revolving fund that will be set up).

Annex E: Project Map(s) and Coordinates

Please attach any additional maps, if needed, to complement those already provided in Part II, Section 1b of this project document.



Source: Lee, E., K. Ha, N.T.M. Ngoc, A. Surinkum, R. Jayakumar, Y. Kim, and K.B. Hassan. 2017. "Groundwater Status and Associated Issues in the Mekong-Lancang River Basin: International Collaborations to Achieve Sustainable Groundwater Resources." *Journal of Groundwater Science and Engineering* 5 (1): 1–13.

Northern boundary: 14.344721, 103.400917
Western boundary: 13.491628, 102.368202
Southern boundary: 8.554367, 104.895057
Eastern boundary: 10.806830, 106.740760

Annex F: GEF TF / LDCF/ SCCF Core Indicator Worksheet

Core Indicator 7	**Number of shared water ecosystems (fresh or marine) under new or improved cooperative management**					**(Number)**
Indicator 7.1	Level of Transboundary Diagnostic Analysis and Strategic Action Program (TDA/SAP) formulation and implementation					
		Shared water ecosystem	Rating (scale 1-4)			
			PIF stage	Endorsement	MTR	TE
		Cambodia-Mekong Delta aquifer	**1**	**1**	**2**	**4**
Indicator 7.2	Level of Regional Legal Agreements and regional Management Institutions to support its implementation					
		Shared water ecosystem	Rating (scale 1-4)			
			PIF stage	Endorsement	MTR	TE
		Cambodia-Mekong Delta aquifer	**1**	**1**	**2**	**4**
Indicator 7.3	Level of National/Local reforms and active participation of Inter-Ministerial Committee					
		Shared water ecosystem	Rating (scale 1-4)			
			PIF stage	Endorsement	MTR	TE
		Cambodia-Mekong Delta aquifer	**1**	**1**	**2**	**4**
Indicator 7.4	Level of engagement in IWLEARN through participation and delivery of key products					
		Shared water ecosystem	Rating (scale 1-4)			
			PIF stage	Endorsement	MTR	TE
		Cambodia-Mekong Delta aquifer	**1**	**1**	**2**	**4**

Core Indicator 11	**Number of direct beneficiaries disaggregated by gender as co-benefit of GEF investment**					***(Number)***
			Number			
			Expected		Achieved	
			PIF stage	Endorsement	MTR	TE
		Female	*0*	*60 000*		
		Male	*0*	*60 000*		
		Total	*0*	*120 000*		

Annex G: GEF Project Taxonomy Worksheet

GEF 7 TAXONOMY

Annex C

Level 1	**Level 2**	**Level 3**	**Level 4**
☒**Influencing models**			
	☒**Transform policy and regulatory environments**		
	☐**Strengthen institutional capacity and decision-making**		
	☐**Convene multi-stakeholder alliances**		
	☐**Demonstrate innovative approaches**		
	☐**Deploy innovative financial instruments**		

☒**Stakeholders**			
	☐**Indigenous Peoples**		
	☐**Private Sector**		
		☐Capital providers	
		☐Financial intermediaries and market facilitators	
		☐Large corporations	
		☐SMEs	
		☐Individuals/Entrepreneurs	
		☐Non-Grant Pilot	
		☐Project Reflow	
	☐**Beneficiaries**		
	☐**Local Communities**		
	☐**Civil Society**		
		☐Community Based Organization	
		☐Non-Governmental Organization	
		☐Academia	
		☐Trade Unions and Workers Unions	
	☒**Type of Engagement**		
		☐Information Dissemination	
		☒Partnership	
		☐Consultation	
		☐Participation	
	☐**Communications**		
		☐Awareness Raising	
		☐Education	
		☐Public Campaigns	
		☐Behavior Change	
☒**Capacity, Knowledge and Research**			
	☐**Enabling Activities**		
	☐**Capacity Development**		
	☒**Knowledge Generation and Exchange**		
	☐**Targeted Research**		
	☐**Learning**		
		☐Theory of Change	
		☐Adaptive Management	
		☐Indicators to Measure Change	
	☐**Innovation**		
	☐**Knowledge and Learning**		
		☐Knowledge Management	
		☐Innovation	
		☐Capacity Development	
		☐Learning	
	☐**Stakeholder Engagement Plan**		
☒**Gender Equality**			
	☒**Gender Mainstreaming**		
		☐Beneficiaries	
		☐Women groups	
		☐Sex-disaggregated indicators	
		☐Gender-sensitive indicators	
	☐**Gender results areas**		
		☐Access and control over natural resources	
		☐Participation and leadership	
		☐Access to benefits and services	
		☐Capacity development	
		☐Awareness raising	
		☐Knowledge generation	
☒**Focal Areas/Theme**			
	☐**Integrated Programs**		
		☐Commodity Supply Chains ([2]Good Growth Partnership)	
			☐Sustainable Commodities Production

[2]

			☐Deforestation-free Sourcing
			☐Financial Screening Tools
			☐High Conservation Value Forests
			☐High Carbon Stocks Forests
			☐Soybean Supply Chain
			☐Oil Palm Supply Chain
			☐Beef Supply Chain
			☐Smallholder Farmers
			☐Adaptive Management
		☐Food Security in Sub-Sahara Africa	
			☐Resilience (climate and shocks)
			☐Sustainable Production Systems
			☐Agroecosystems
			☐Land and Soil Health
			☐Diversified Farming
			☐Integrated Land and Water Management
			☐Smallholder Farming
			☐Small and Medium Enterprises
			☐Crop Genetic Diversity
			☐Food Value Chains
			☐Gender Dimensions
			☐Multi-stakeholder Platforms
		☐Food Systems, Land Use and Restoration	
			☐Sustainable Food Systems
			☐Landscape Restoration
			☐Sustainable Commodity Production
			☐Comprehensive Land Use Planning
			☐Integrated Landscapes
			☐Food Value Chains
			☐Deforestation-free Sourcing
			☐Smallholder Farmers
		☐Sustainable Cities	
			☐Integrated urban planning
			☐Urban sustainability framework
			☐Transport and Mobility
			☐Buildings
			☐Municipal waste management
			☐Green space
			☐Urban Biodiversity
			☐Urban Food Systems
			☐Energy efficiency
			☐Municipal Financing
			☐Global Platform for Sustainable Cities
			☐Urban Resilience
	☐**Biodiversity**		
		☐Protected Areas and Landscapes	
			☐Terrestrial Protected Areas
			☐Coastal and Marine Protected Areas
			☐Productive Landscapes
			☐Productive Seascapes
			☐Community Based Natural Resource Management
		☐Mainstreaming	
			☐Extractive Industries (oil, gas, mining)
			☐Forestry (Including HCVF and REDD+)
			☐Tourism
			☐Agriculture & agrobiodiversity
			☐Fisheries
			☐Infrastructure
			☐Certification (National Standards)
			☐Certification (International Standards)
		☐Species	
			☐Illegal Wildlife Trade
			☐Threatened Species

			☐Wildlife for Sustainable Development
			☐Crop Wild Relatives
			☐Plant Genetic Resources
			☐Animal Genetic Resources
			☐Livestock Wild Relatives
			☐Invasive Alien Species (IAS)
		☐Biomes	
			☐Mangroves
			☐Coral Reefs
			☐Sea Grasses
			☐Wetlands
			☐Rivers
			☐Lakes
			☐Tropical Rain Forests
			☐Tropical Dry Forests
			☐Temperate Forests
			☐Grasslands
			☐Paramo
			☐Desert
		☐Financial and Accounting	
			☐Payment for Ecosystem Services
			☐Natural Capital Assessment and Accounting
			☐Conservation Trust Funds
			☐Conservation Finance
		☐Supplementary Protocol to the CBD	
			☐Biosafety
			☐Access to Genetic Resources Benefit Sharing
	☐**Forests**		
		☐Forest and Landscape Restoration	
			☐REDD/REDD+
		☐Forest	
			☐Amazon
			☐Congo
			☐Drylands
	☐**Land Degradation**		
		☐Sustainable Land Management	
			☐Restoration and Rehabilitation of Degraded Lands
			☐Ecosystem Approach
			☐Integrated and Cross-sectoral approach
			☐Community-Based NRM
			☐Sustainable Livelihoods
			☐Income Generating Activities
			☐Sustainable Agriculture
			☐Sustainable Pasture Management
			☐Sustainable Forest/Woodland Management
			☐Improved Soil and Water Management Techniques
			☐Sustainable Fire Management
			☐Drought Mitigation/Early Warning
		☐Land Degradation Neutrality	
			☐Land Productivity
			☐Land Cover and Land cover change
			☐Carbon stocks above or below ground
		☐Food Security	
	☒**International Waters**		
		☐Ship	
		☐Coastal	
		☒Freshwater	
			☒Aquifer
			☐River Basin
			☐Lake Basin
		☐Learning	
		☐Fisheries	

		☐Persistent toxic substances	
		☐SIDS : Small Island Dev States	
		☐Targeted Research	
		☐Pollution	
			☐Persistent toxic substances
			☐Plastics
			☐Nutrient pollution from all sectors except wastewater
			☐Nutrient pollution from Wastewater
		☒Transboundary Diagnostic Analysis and Strategic Action Plan preparation	
		☐Strategic Action Plan Implementation	
		☐Areas Beyond National Jurisdiction	
		☐Large Marine Ecosystems	
		☐Private Sector	
		☐Aquaculture	
		☐Marine Protected Area	
		☐Biomes	
			☐Mangrove
			☐Coral Reefs
			☐Seagrasses
			☐Polar Ecosystems
			☐Constructed Wetlands
	☐**Chemicals and Waste**		
		☐Mercury	
		☐Artisanal and Scale Gold Mining	
		☐Coal Fired Power Plants	
		☐Coal Fired Industrial Boilers	
		☐Cement	
		☐Non-Ferrous Metals Production	
		☐Ozone	
		☐Persistent Organic Pollutants	
		☐Unintentional Persistent Organic Pollutants	
		☐Sound Management of chemicals and Waste	
		☐Waste Management	
			☐Hazardous Waste Management
			☐Industrial Waste
			☐e-Waste
		☐Emissions	
		☐Disposal	
		☐New Persistent Organic Pollutants	
		☐Polychlorinated Biphenyls	
		☐Plastics	
		☐Eco-Efficiency	
		☐Pesticides	
		☐DDT - Vector Management	
		☐DDT - Other	
		☐Industrial Emissions	
		☐Open Burning	
		☐Best Available Technology / Best Environmental Practices	
		☐Green Chemistry	
	☐**Climate Change**		
		☐**Climate Change Adaptation**	
			☐Climate Finance
			☐Least Developed Countries
			☐Small Island Developing States
			☐Disaster Risk Management
			☐Sea-level rise
			☐Climate Resilience
			☐Climate information
			☐Ecosystem-based Adaptation
			☐Adaptation Tech Transfer
			☐National Adaptation Programme of Action
			☐National Adaptation Plan
			☐Mainstreaming Adaptation

			☐Private Sector
			☐Innovation
			☐Complementarity
			☐Community-based Adaptation
			☐Livelihoods
		☐**Climate Change Mitigation**	
			☐Agriculture, Forestry, and other Land Use
			☐Energy Efficiency
			☐Sustainable Urban Systems and Transport
			☐Technology Transfer
			☐Renewable Energy
			☐Financing
			☐Enabling Activities
		☐**Technology Transfer**	
			☐Poznan Strategic Programme on Technology Transfer
			☐Climate Technology Centre & Network (CTCN)
			☐Endogenous technology
			☐Technology Needs Assessment
			☐Adaptation Tech Transfer
		☐**United Nations Framework on Climate Change**	
			☐Nationally Determined Contribution

Annex H: Work Plan (indicative)

Output	Main Activities	Responsible	Year 1				Year 2				Year 3				Year 4				Year 5			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Component 1: Joint science-based diagnostic for groundwater dynamics (recharge and extraction) and effects on ecosystems (e.g. fish, wetlands) and livelihoods																						
Output.1.1 Assessment of current state of groundwater resources, recharge and extraction dynamics.	Identify candidates, select and contract national TDA teams	UNESCO IHP, national teams; IUCN																				
	Joint transboundary assessment of hydrological state of groundwater resources, recharge and extraction dynamics																					
	Joint transboundary assessment of socio-economic state of groundwater resources, including gender analysis																					
	Detailed assessment of governance of groundwater and underpinning drivers, incl. surface water use and land use change																					
Output 1.2 Analysis of groundwater related dependencies of related ecosystems	Identification and specification of groundwater dependent ecosystems	UNESCO IHP, national teams; IUCN																				
	Analysis of monitoring data relevant for groundwater dependent ecosystems																					
	Identification of possible intervention points for safeguarding groundwater dependent ecosystems																					

Output	Main Activities	Responsible	Year 1				Year 2				Year 3				Year 4				Year 5			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Output 1.3 Agreed upon Transboundary Diagnostic Analysis (TDA), including assessment of related governance, socio-economic, legal and gender aspects.	Joint transboundary assessment of socio-economic state of groundwater resources	MERFI, national teams; IUCN																				
	Specify cause effect connections between bio-physical and socio-economic indicators																					
	Identify key drivers for prioritized problems																					
	Integrated assessment																					
	Ongoing assessment of pilot / SAP options																					
	Gender analysis	UNESCO WWAP																				
Output 1.4 Agreement reached on Environmental Status Indicators.	Identify and agree on key policy indicators for the sustainable development of both target basins	MERFI, national teams; IUCN																				
Component 2: Piloting solutions for improved transboundary groundwater management																						
Output 2.1 Pilot demonstrations of innovative groundwater management and utilization after adequate feasibility studies	Design pilot demonstration project	PMU; Cambodia and Viet Nam governments																				
	Selection of demonstration sites	PMU; Cambodia and Viet Nam governments																				
	Select and contract implementation teams	PMU; Cambodia and Viet Nam governments																				
	Conduct demonstration projects	National teams in Cambodia & Viet Nam; Cambodia and Viet Nam governments																				
	Assess demonstration project results	National teams in Cambodia & Viet Nam; Cambodia and																				

Output	Main Activities	Responsible	Year 1				Year 2				Year 3				Year 4				Year 5			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
		Viet Nam governments																				
Component 3: Transboundary cooperation mechanisms																						
Output 3.1 Harmonized design of groundwater monitoring networks and protocols	Propose technical framework for a regional groundwater data collection and management that includes a groundwater monitoring to CMRDA	UNESCO IHP, National teams; IUCN																				
	Reach an agreement among countries on common goals, responsible institutions, types of data/info required to be shared, frequency and means of communication, maintenance and support of common information portal, etc.																					
	Capacity building on groundwater monitoring																					
	Analysis of cuurent monitoring practices and necessary improvements																					
	Joint plan on futher monitoring needs and implementation steps																					
	Gender-inclusive recruitment of groundwater monitoring system operators																					
	Purchase and install monitoring equipment																					

Output	Main Activities	Responsible	Year 1				Year 2				Year 3				Year 4				Year 5			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Output 3.2 Agreement on groundwater data exchange mechanisms and procedures.	Assessment of existing data and data management solutions in Cambodia and Viet Nam and comparison with state-of-the-art solutions	UNESCO IHP, National teams; UNESCO WWAP; IUCN																				
	Identification of data sharing potential and resulting benefit for specific government agencies																					
	Prepare a draft agreement for organizing and implementing the regular exchange of data information based on the requirements and needs of countries																					
Output 3.3 Design of permanent transboundary consultation and coordination body (TCCB)	Identification and selection of key province and central Government agencies and staff	IUCN; MERFI; CNMC, VNMC																				
	Definition and agreement of roles																					
	Inception meeting of TCCB																					
Component 4: Commitment reached among countries on implementing priority legal, institutional and policy reforms and investments for the protection and equitable utilization of the shared aquifer and its' dependent ecosystem.																						
Output 4.1 Countries establish ad hoc inter-ministerial committees (IMCs).	Identification and selection of key province and central Government agencies and staff	IUCN; CNMC, VNMC																				
	Definition and agreement of roles																					
	Inception meeting of IMCs																					
Output 4.2 A shared long-term Vision (horizon 20	Assessment of main drivers and trends; specification of indicators																					

Output	Main Activities	Responsible	Year 1				Year 2				Year 3				Year 4				Year 5			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
years) including the agreement on environmental quality targets.	Conduct two visioning workshops (most desirable, least desirable, and most likely futures)	IUCN; UNESCO WWAP, MERFI																				
	Analysis of workshop results and writing of visioning report																					

Output	Main Activities	Responsible	Year 1				Year 2				Year 3				Year 4				Year 5			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Output 4.3 Strategic Action Program (SAP) with horizon of 5 years, consistent with the Shared Vision.	SAP Workshop 1: Present vision assessment and possible intervention points; draft action program	IUCN; UNESCO WWAP; MERFI																				
	SAP workshop 2: Present intermediate results from demonstration projects																					
	SAP workshop 3: Present scientific assessments to decision makers and revise SAP																					
Component 5: Reinforced institutional capacity, improved participation, gender mainstreaming, monitoring and coordination.																						
Output 5.1 Structured capacity building in groundwater governance for decision makers and other stakeholders.	Conduct Stakeholder analysis at national and transboundary level for capacity building programming purposes	IUCN; UNESCO IHP																				
	Conduct capacity building needs assessment at national and transboundary level (baseline)																					
	Develop tailor-made structured capacity building programme menu (including the modules)																					
	Design and organize series of trainings at national and transboundary level (including study visits)																					
	Develop capacity building database and dashboard																					
	Design the tailor-made structured capacity building programme menu including training courses in groundwater governance, domestic and transboundary,																					

Output	Main Activities	Responsible	Year 1				Year 2				Year 3				Year 4				Year 5			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	covering the legal, institutional and policy domains																					
	Establishing a Gender Focal Points system																					
	Monitoring gender and minority inclusion across project cycle																					
	Defining gender responsive M&E system including gender, minority and TBA water indicators																					
	Identification of gender and ethnicity capacity development needs																					
	Development and delivery of TBA gender integration training modules																					
	Preparation of guidelines on Gender integration into TBA management																					
	Monitoring gender-inclusive recruitment processes for technical and ledership project positions																					
	Assess training effectiveness																					
Output 5.2 Annual stocktaking and awareness raising meetings with relevant stakeholders (e.g. local, national and regional meetings).	Prepare stakeholder workshop input material																					
	Follow-up meetings																					

Output	Main Activities	Responsible	Year 1				Year 2				Year 3				Year 4				Year 5			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Outcome 5.3 Water and Gender Action Plans and indicators, based on results of Component 1, adopted by relevant authorities in both countries.	Specify gender-sensitive indicators for groundwater use, related livelihoods, and dependent ecosystems	UNESCO WWAP; IUCN																				
	Draft actions to improve agreed gender-sensitive indicators over a specified time frame with selected monitoring mechanisms																					
	Implementation of actions in partner country investments, plans and policies																					
Output 5.4 Periodic events for the coordination with other ongoing initiatives organized by the PMU/TCCB.	Identify and maintain communication with ongoing initiatives relevant for the Cambodia Mekong Delta Aquifer.	IUCN; UNESCO IHP; MERFI																				
	Organize periodic events and document cross-initiative actions																					

Output	Main Activities	Responsible	Year 1				Year 2				Year 3				Year 4				Year 5			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Output 5.5 Full participation to GEF IW LEARN activities, creation of a project website, and preparation of experience notes.	Discussions with IW LEARN	IUCN; UNESCO IHP; UNESCO WWAP; MERFI																				
	Development of Communications Plan and Knlowledge Management Plan																					
	Creation of project website, curation of content and development of communication and konwledgde sharing material																					
	Participation in IWC conferences and relevant events																					
	Develop TBA and Gender online resource library including key resources on gender, youth and minority																					

Annex I1: Environmental and Social Risk Certification

Project Risk Certification

Entity Number: 673261
Project Title: Enhancing sustainability of the Transboundary Cambodia - Mekong River Delta Aquifer
Recipient Country(ies): Regional Asia & Pacific
Estimated total budget in USD: USD 15 000 000

Risk Certification

Certified by: Whiting, Louise (RAPDD)

Date: 17-Feb-2020

The proposed action is classified as: **Low**

ESS Narrative: The project's objective is to strengthen environmental sustainability and water security in the Lower Mekong Basin by investing, for the first time, in improved governance and sustainable utilization of the Cambodia-Mekong River Delta Transboundary Aquifer. The project has been assessed according to FAO's Environmental and Social risks, against several sets of relevant criteria including on: natural resources management; biodiversity, ecosystems and natural habitats; involuntary resettlement; decent work; gender equality and indigenous peoples. Risk assessment criteria involved, among others, potential degradation risks of key resources, land and water; water management practices that may have an impact on agriculture, environment and livelihoods, with subsequent socioeconomic impacts, also to vulnerable populations; access to water, potential increase in GHG emissions. It also considered potential impacts on indigenous peoples as well as into gender equality. Taking into consideration the project ranked as low-risk. The project formulation team has not identified any further risks during the development of the FSP. In fact, the project is expected to positively impact the populations in the CMDA area, by improving water governance and showcase solutions through the pilot applications for sustainable water use of shared water resources. During the project implementation, any potential risks identified, will be considered by the Project Steering Committee and the PMU and relevant technical experts will due action to mitigate these.

Annex I2: Stakeholder Engagement Matrix and Grievance Redress Mechanism

1) Stakeholder Consultation in project formulation

Stakeholder Name	Stakeholder Type	Stakeholder profile	Consultation Methodology	Consultation Findings	Date	Comments
H.E Choup Paris, GDEKI	**Direct beneficiary**	*National Government Institution body*	*Face to face meeting*	*Agreed on scope of the project and project design and work plan*	16-Nov 2020	
H.E Khieu Borin ,GDLC	*Indirect Beneficiary*	*National Government Institution body*	*Face to face meeting*	*Sharing information and data for formulation of the project and agreed on co-finance letter*	18-Nov 2020	
NCSD	*Indirect Beneficiary*	*National Government Institution body*	*Face to face meeting*	*Sharing information and data for formulation of the project and agreed on co-finance letter*	18-Nov 2020	

GDANCP	*Indirect Beneficiary*	*National Government Institution body*	*Face to face meeting*	*Sharing information and data for formulation of the project and agreed on co-finance letter with additional comments on PD*	24-Nov 2020	
MAFF: GDA	*Indirect Beneficiary*	*National Government Institution body*	Zoom meeting	*Sharing information and data for formulation of the project and agreed on co-finance letter with additional comments on PD*	01-Dec 2020	
MAFF: FiA	*Indirect Beneficiary*	*National Government Institution body*	Zoom Meeting	*Sharing information and data for formulation of the project and provide additional comments on PD*	06 Dec 2020	
MOWRAM: PMU, DHRW, DIA, DWSS, Head of Gender, CNMC, TSA	*Indirect Beneficiary*	*National Government Institution body*	Zoom Meeting	*Sharing information about MOWRAM activities related to surface and groundwater and comments to improve the PD*	02-Dec 2020	*Second meeting is required*
CNMC	*Indirect Beneficiary*	*National Government Institution body*	Face to Face meeting	*Sharing information data for formulation of the project and agreed on co-finance letter with additional comments on PD*	20-Nov 2020	
MRD: DRWS, Head of Gender	*Indirect Beneficiary*	*National Government Institution body*	Zoom meeting	*Sharing information data for formulation of the project and agreed on co-finance letter with additional comments on PD*	17-Nov 2020	
MoWA	*Partner*	*National Government Institution body*	Zoom meeting	*Sharing information and data for formulation of the project*	30 Nov 2020	
Svay Rieng						
PDOE	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	26-Nov 2020	
PDAFF	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	27-Nov 2020	
PDRD	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	27-Nov 2020	
Field visit to community	*Indirect Beneficiary*	*Local community*	Direct Interview	*Collect information about positive and negative and issues related groundwater water use and roles gender participation in groundwater uses*	28 Nov 2020	
Prey Veng						
PDOE	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	03-Dec 2020	
PDAFF	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	04-Dec 2020	
PDRD	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection*	04-Dec 2020	

				and collect comments for including in updated PD		
Field visit to community	*Indirect Beneficiary*	*Local community*	Direct Interview	*Collect information about positive and negative and issues related groundwater water use and roles gender participation in groundwater uses*	05- Dec 2020	
Kg. Cham						
PDOE	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	08-Dec 2020	
PDRD	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	09-Dec 2020	
PDAFF	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	10-Dec 2020	
Siem Reap						
PDOE	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	16-Dec 2020	
PDAFF	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	17-Dec 2020	
PDRD	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	17-Dec 2020	
Field visit to community	*Indirect Beneficiary*	*Local community*	Direct Interview	*Collect information about positive and negative and issues related groundwater water use and roles gender participation in groundwater uses*	18 Dec 2020	
Sihanoukville						
PDOE	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	23-Dec 2020	
PDAFF	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	24-Dec 2020	
PDRD	*Indirect Beneficiary*	*Local Government Institution/body*	Face to Face meeting	*Sharing information about the project, data collection and collect comments for including in updated PD*	24-Dec 2020	

Stakeholder Consultation in project Implementation

Stakeholder Name	Stakeholder Type	Stakeholder profile	Consultation Methodology	Expected timing	Comments
MOWRAM	**Direct beneficiary**	*National Government Institution body*	*Face to face meeting And online communication*	Daily	

MOE	*Indirect Beneficiary*	*National Government Institution body*	*Partner meeting, Regular technical meeting, working group and working session*	Monthly	
GDEKI, MOE	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
GDLC, MOE	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
NCSD, MOE	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
GDANCP, MOE	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
MAFF	*Indirect Beneficiary*	*National Government Institution body*	*Partner meeting, Regular technical meeting, working group and working session*	Monthly	
GDA, MAFF	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
MAFF: FiA	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
DHRW, MOWRAM	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
DIA, MOWRAM	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
DWSS, MOWRAM	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
Head of Gender, MOWRAM	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
TSA	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
CNMC	*Indirect Beneficiary*	*National Government Institution body*	*Partner meeting, Regular technical meeting, working group and working session*	Monthly	
MRD	*Indirect Beneficiary*	*National Government Institution body*	*Partner meeting, Regular technical meeting, working group and working session*	Monthly	
DRWS, MRD	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
Head of Gender, MRD	*Indirect Beneficiary*	*National Government Institution body*	*Regular meeting, working group and working session*	Quarterly	
MoWA	*Partner*	*National Government Institution body*	*Partner meeting, Regular technical meeting, working group and working session*	Monthly	
Provincial departments of the targeted provinces					
PDOE	*Indirect Beneficiary*	*Local Government Institution/body*	*Regular meeting, working group and working session and field visit*	Quarterly	
PDAFF	*Indirect Beneficiary*	*Local Government Institution/body*	*Regular meeting, working group and working session and field visit*	Quarterly	
PDRD	*Indirect Beneficiary*	*Local Government Institution/body*	*Regular meeting, working group and working session and field visit*	Quarterly	
Local Community execute the pilot study	*Indirect Beneficiary*	*Local community*	*Regular meeting, working group and working session and field visit*	Quarterly	

International organisation (MRCS, MERFI) and CSOs	*Partner*	*International Government Institution/body*	*Provide technical support and advices for project implementation and participate in the annual meeting*	Annually/semesterly	
Donor organizations (e.g. World Bank, ADB, BMBF, NWO)	*Partner*	*Resource Partner/Donor*	*Participation to the annual meeting of the project and capture the progress and comments for improvement*	Annually	
National CSOs (e.g. Action Aid Cambodia; Gender and Development; Cambodian National Council for Women; Cooperation Committee for Cambodia	*Partner*	*Civil Society Organization*	*Provide inputs on design of pilot study and development of national strategy and actions plan*	Annually	
Private sectors community	*Indirect Beneficiary*	*Non-Gonvernmental Organization*	*Participate in the development processes of the project and create partnership on project investment*	Annually	

Grievance Redress Mechanism

- Grievance Mechanism

Focal Point Information	Mr. Jongjin Kim, ADG, FAO Regional Office for Asia Pacific, Bangkok
Contact Details	Rap-adg@fao.org
Explain how the grievance mechanism will be/ has been communicated to stakeholders	The project will produce a brochure in English, Cambodian (Khmer) and Vietnamese languages on the project, including contact details for grievances. This will include contacts for FAO Representatives in each country and well as for the Assistant Director General of FAO Regional Office for Asia and the Pacific, who is the designated budget holder for this project.

FAO is committed to ensuring that its programs are implemented in accordance with the Organization's environmental and social obligations. In order to better achieve these goals, and to ensure that beneficiaries of FAO programs have access to an effective and timely mechanism to address their concerns about non-compliance with these obligations, the Organization, in order to supplement measures for receiving, reviewing and acting as appropriate on these concerns at the program management level, has entrusted the Office of the Inspector-General with the mandate to independently review the complaints that cannot be resolved at that level.

FAO will facilitate the resolution of concerns of beneficiaries of FAO programs regarding alleged or potential violations of FAO's social and environmental commitments. For this purpose, concerns may be communicated in accordance with the eligibility criteria of the Guidelines for Compliance Reviews Following Complaints Related to the Organization's Environmental and Social Standards, which applies to all FAO programs and projects.

Concerns must be addressed at the closest appropriate level, i.e. at the project management/technical level, and if necessary at the Regional Office level. If a concern or grievance cannot be resolved through consultations and measures at the project management level, a complaint requesting a Compliance Review may be filed with the Office of the Inspector-General (OIG) in accordance with the Guidelines. Program and project managers will have the responsibility to address concerns brought to the attention of the focal point.

The principles to be followed during the complaint resolution process include: impartiality, respect for human rights, including those pertaining to Indigenous Peoples, compliance of national norms, coherence with the norms, equality, transparency, honesty, and mutual respect.

Project-level grievance mechanism

The project will establish a grievance mechanism at field level to file complaints during project inception phase. Contact information and information on the process to file a complaint will be disclosed in all meetings, workshops and other related events throughout the life of the project. In addition, it is expected that all awareness raising material to be distributed will include the necessary information regarding the contacts and the process for filing grievances.

The project will also be responsible for documenting and reporting as part of the safeguards performance monitoring on any grievances received and how they were addressed.

The mechanism includes the following stages:

- In the instance in which the claimant has the means to directly file the claim, he/she has the right to do so, presenting it directly to the Project Management Unit (PMU). The process of filing a complaint will duly consider anonymity as well as any existing traditional or indigenous dispute resolution mechanisms and it will not interfere with the community's self-governance system.
- The complainant files a complaint through one of the channels of the grievance mechanism. This will be sent to the Project Coordinator (PC) to assess whether the complaint is eligible. The confidentiality of the complaint must be preserved during the process.
- The PGC will be responsible for recording the grievance and how it has been addressed if a resolution was agreed.
- If the situation is too complex, or the complainer does not accept the resolution, the complaint must be sent to a higher level, until a solution or acceptance is reached.
- For every complaint received, a written proof will be sent within ten (10) working days; afterwards, a resolution proposal will be made within thirty (30) working days.
- In compliance with the resolution, the person in charge of dealing with the complaint, may interact with the complainant, or may call for interviews and meetings, to better understand the reasons.
- All complaint received, its response and resolutions, must be duly registered.

Internal process

1. Project Management Unit (PMU). The complaint could come in writing or orally to the PMU directly. At this level, received complaints will be registered, investigated and solved by the PMU.

2. If the complaint has not been solved and could not be solve in level 1, then the Project Coordinator (PC) elevates it to the FAO Representative of Cambodia and/or Viet Nam.

3. Project Steering Committee (PSC). The assistance of the PSC is requested if a resolution was not agreed in levels 1 and 2.

4. FAO Regional Office for Asia and the Pacific. FAO Representative will request if necessary the advice of the Regional Office to resolve a grievance, or will transfer the resolution of the grievance entirely to the regional office, if the problem is highly complex.

5. The FAO Regional Representative will request only on very specific situations or complex problems the assistance on the FAO Inspector General who pursuits its own procedures to solve the problem.

Resolution

Upon acceptance a solution by the complainer, a document with the agreement should be signed with the agreement.

Project Management Unit (PMU)	Must respond within 5 working days.	
FAO Representation in Cambodia	Anyone in the FAO Representation may receive a complaint and must request proof of receipt. If the case is accepted, the FAO Representative must respond within 5 working days in consultation with FAO's Representation and Project Team. FAO Representative Cambodia e-mail: FAO-KH@fao.org Tel:___	
FAO Representation in Viet Nam	Anyone in the FAO Representation may receive a complaint and must request proof of receipt. If the case is accepted, the FAO Representative must respond within 5 working days in consultation with FAO's Representation and Project Team. FAO Representative Viet Nam e-mail: FAO-VN@fao.org Tel: (84 4) 38500100	
Project Steering Committee (PSC)	If the case cannot be dealt by the FAO Representative, he/she must send the information to all PSC members and call for a meeting to find a solution. The response must be sent within 5 working days after the meeting of the PSC.	
FAO Regional Office for Asia and the Pacific	Must respond within 5 working days in consultation with FAO's Representation. FAO Assistant Director General e-mail: FAO-RAP@fao.org Tel: (+66 2) 697 4000	

Office of the Inspector General (OIG)	To report possible fraud and bad behavior by fax, confidential: (+39) 06 570 55550 By e-mail: Investigations-hotline@fao.org By confidential hotline: (+ 39) 06 570 52333	

Annex J: Indigenous Peoples

As described in the main text of the project document, Indigenous Peoples account for 2 percent of the total population that lives in the extended CMDA area. The indigenous ethnic minority groups in Cambodia are the most vulnerable in regards to their rights to access and utilize the land for traditional rice and crop plantation as well as right to access the Non-timber Forest Products in the forest. The vulnerability is due to the rapid growth of social and economic land concession, hydropower dam development, large scale agro-industrial crop, and illegal logging and mining activities. Thus, despite their legally recognized land and natural resources rights, they are faced with tenure insecurity. Consequently, water access of indigenous communities for either household consumption or irrigation during the dry season is increasingly difficult despite high availability of water access (either surface or groundwater).

The main ethnic minorities in Viet Nam's Mekong Delta are Khmer, Chinese, and Cham people. They own fewer assets and their income is generally lower than ethnic minorities in other regions of Viet Nam. The poverty rate among Khmer minority households in Viet Nam's Mekong delta is high with nearly 20 percent, compared to an average of 8 percent for the entire population. This emphasizes that the rich-poor disparity between ethnic groups is still very high.

The project is not expected to adversely affect Indigenous Peoples. The development and management of groundwater in the Mekong Delta Aquifer needs to consider socioeconomic and livelihood related conditions of indigenous communities. The project aspires to showcase in Component 2 water efficient and climate resilient technologies such as climate smart agriculture, drip irrigation systems, non-timber forest products collection and processing as well as diversifying into groundwater and surface water related tourism activities. This will help Indigenous Peoples diversify their livelihoods from traditional yet unproductive rice cultivation, livestock production and crop plantation to be more environmentally friendly. Moreover, it will improve Indigenous Peoples' representation in the social and public sphere's decision making, by engaging Ips in relevant consultations, enabling their interests and benefits related to groundwater management and livelihood diversification are be taken into consideration.

Project beneficiaries will be identified during early stages of implementation. In case there are Indigenous Peoples are identified among project beneficiaries, Free, Prior and Informed Consent (FPIC) will be obtained as necessary.

Annex K: FAO'S Roles in Internal Organization

Note for Formulator: this version of the project document template can be used only when all MS 701 conditions have been met and the ADG PS has approved the use of OPIM with selected Operational Partners.

FAO will be the GEF Implementing Agency of the project. As such, FAO has the project assurance role and will supervise and provide technical guidance for the overall implementation of the project, including:

a) Monitor and oversee OP's compliance with the OPA and project implementation in accordance with the project document, work plans, budgets, agreements with co-financiers and the rules and procedures of FAO and GEF;

b) Commence and completing the responsibilities allocated to it in the Project Document in a timely manner, provided that all necessary reports and other documents are available;

c) Making transfers of funds, supplies and equipment, as applicable, in accordance with the provisions of the OPA;

d) Administrate the portion of project GEF funds that has been agreed with the OP to remain for FAO direct implementation. These funds will be managed in accordance with the rules and procedures of FAO;

e) organizing and completing monitoring, assessment, assurance activities and evaluation of the Project;

f) Review, discuss with the OP, and approve the project progress and financial reports, as detailed in the OPA and its annexes. undertaking and completing monitoring, assessment, assurance activities, evaluation and oversight of the project;

g) Liaising on an ongoing basis, as needed, with the Government (as applicable), other members of the United Nations Country Team, Resource Partner, and other stakeholders;

h) Providing overall guidance, oversight, technical assistance and leadership, as appropriate, for the Project;

i) Provide financial and audit services to the project including budget release, budget revisions and administration of funds from GEF in accordance with rules and procedures of FAO;

j) oversee financial expenditures against project budgets;

k) ensure that all activities, including procurement and financial services are carried out in strict compliance with FAO and GEF relevant procedures and agreements;

l) Initiating joint review meetings with the OP to agree on the resolution of findings and to document the lessons learned;

m) Report to the GEF Secretariat and Evaluation Office, through the annual Project Implementation Review, on project progress and provide consolidated financial reports to the GEF Trustee;

n) Conduct at least one supervision mission per year

o) Lead the Mid-Term Review and Final Evaluation;

p) Monitor implementation of the plan for social and environmental safeguards, in accordance with the FAO Environmental and Social Safeguards.

q) trigger additional reviews, audits and/or evaluations, as necessary;

In collaboration with the Project Management Unit (PMU) and under the overall guidance of the Project Steering Committee, FAO will participate in the planning of contracting and technical selection processes. FAO will process fund transfers to the OP as per provisions, terms and conditions of the signed OPA.

The FAO Assistant Director General, Regional Office Asia and the Pacific will be the Budget Holder (BH) and will be responsible for timely operational, and financial management of GEF resources implemented -. The budget holder will be also responsible for (i) managing OPIM for results, including monitoring of risks and overall compliance with the OPA provisions; (ii) review and clear financial and progress reports received from the OP and certify request for funds (iii) review and clear budget revisions and annual work plan and budgets; (iv) ensure implementation of the Risk Mitigation and Assurance Plan v) follow up and ensure that the OP implements all actions and recommendations agreed upon during Assurance Activities.

As a first step in the implementation of the project, the FAO Representation will establish an interdisciplinary Project Task Force (PTF) within FAO, to guide the implementation of the project. The PTF is a management and consultative body that integrate the necessary technical qualifications from the FAO relevant units to support the project. The PTF is composed of a Budget Holder, a Lead Technical Officer (LTO), the Funding Liaison Officer (FLO) and one or more technical officers based on FAO Headquarters (HQ Technical Officer).

The FAO Assistant Director General, Regional Office Asia and the Pacific, in accordance with the PTF, will give its non-objection to the AWP/Bs submitted by the PMU as well as the Project Progress Reports (PPRs). PPRs may be commented by the PTF and should be approved by the LTO before being uploaded by the BH in FPMIS.
The Lead Technical Officer (LTO) for the project will be Ms. Louise Whiting, Water Management Officer, FAO Regional Office Asia and the Pacific. The role of the LTO is central to FAO's comparative advantage for projects. The LTO will oversee and carry out technical backstopping to the project implementation. The LTO will support the Budget Holder in monitoring of the technical quality of results achieved by LOPs, in the monitoring of the AWP/Bs, including work plan and budget revisions. The LTO is responsible and accountable for providing or obtaining technical clearance of technical inputs and services procured by the Organization.

In addition, the LTO will provide technical backstopping to the PMU to ensure the delivery of quality technical outputs. The LTO will coordinate the provision of appropriate technical support from PTF to respond to requests from the PSC. The LTO will be responsible for:

a) Assess the technical expertise required for project implementation and identify the need for technical support and capacity development of the OP.

b) Provide technical guidance to the OP on technical aspects and implementation.

c) Review and give no-objection to TORs for consultancies and contracts to be performed under the project, and to CVs and technical proposals short-listed by the PMU for key project positions and services to be financed by GEF resources;

d) Review and give clearance for the OP's procurement plans;

e) Supported by the FAO Assistant Director General, Regional Office Asia and the Pacific review and clear final technical products delivered by consultants and contract holders financed by GEF resources;

f) Assist with review and provision of technical comments to draft technical products/reports during project implementation;

g) Review and approve project progress reports submitted by the National Program Director (NPD), in cooperation with the BH;

h) Support the FAO Assistant Director General, Regional Office Asia and the Pacific in examining, reviewing and giving no-objection to AWP/B submitted by the NPD, for their approval by the Project Steering Committee;

i) Ensure the technical quality of the six-monthly Project Progress Reports (PPRs). The PPRs will be prepared by the NPD, with inputs from the PMU. The BH will submit the PPR to the FAO/GEF Coordination Unit for comments, and the LTO for technical clearance. The PPRs will be submitted to the PSC for approval twice a year. The FLO will upload the approved PPR to FPMIS.

j) Supervise the preparation and ensure the technical quality of the annual PIR. The PIR will be drafted by the NPD, with inputs from the PT. The PIR will be submitted to the BH and the FAO-GEF Coordination Unit for approval and finalization. The FAO/GEF Coordination Unit will submit the PIRs to the GEF Secretariat and the GEF Evaluation Office, as part of the Annual Monitoring Review report of the FAO-GEF portfolio. The LTO must ensure that the NPD and the PMU have provided information on the co-financing provided during the year for inclusion in the PIR;

k) Conduct annual supervision missions;

l) Provide comments to the TORs for the mid-term and final evaluation; provide information and share all relevant background documentation with the evaluation team; participate in the mid-term workshop with all key project stakeholders, development of an eventual agreed adjustment plan in project execution approach, and supervise its implementation; participate in the final workshop with all key project stakeholders, as relevant. Contribute to the follow-up to recommendations on how to insure sustainability of project outputs and results after the end of the project.

m) Monitor implementation of the Risk Mitigation Plan, in accordance with the FAO Environmental and Social Safeguards.

The HQ Technical Officer is a member of the PTF, as a mandatory requirement of the FAO Guide to the Project Cycle. The HQ Technical Officer has most relevant technical expertise - within FAO technical departments - related to the thematic of the project. The HQ Technical Officer will provide effective functional advice to the LTO to ensure adherence to FAO corporate technical standards during project implementation, in particular:

a) Supports the LTO in monitoring and reporting on implementation of environmental and social commitment plans for moderate risk projects. In this project, the HQ officer will support the LTO in monitoring and reporting the identified risks and mitigation measures (Appendix H2) in close coordination with the OP.

b) Provides technical backstopping for the project work plan.

c) Clears technical reports, contributes to and oversees the quality of Project Progress Report(s).

d) May be requested to support the LTO and PTF for implementation and monitoring.

e) Contribute to the overall ToR of the Mid-term and Final Evaluation, review the composition of the evaluation team and support the evaluation function.

The FAO-GEF Coordination Unit will provide Funding Liaison Officer (FLO) functions. This FAO/GEF Coordination Unit will review and provide a rating in the annual PIR(s) and will undertake supervision missions as necessary. The PIRs will be included in the FAO GEF Annual

Monitoring Review submitted to GEF by the FAO GEF Coordination Unit. The FAO GEF Coordination Unit may also participate or lead the mid-term evaluation, and in the development of corrective actions in the project implementation strategy if needed to mitigate eventual risks affecting the timely and effective implementation of the project. The FAO GEF Coordination Unit will in collaboration with the FAO Finance Division to request transfer of project funds from the GEF Trustee based on six-monthly projections of funds needed.

The FAO Financial Division will provide annual Financial Reports to the GEF Trustee and, in collaboration with the FAO-GEF Coordination Unit, request project funds on a six-monthly basis to the GEF Trustee.

Financial management

Financial management in relation to the GEF resources directly managed by FAO will be carried out in accordance with FAO's rules and procedures as outlined below. The OP is accountable to FAO for achieving the agreed project results and for the effective use of resources made available by FAO. Financial management and reporting for the funds transferred to the OP will be done by the OP in accordance with terms, conditions, formats and requirements of FAO and the provisions of the signed Operational Partners Agreement (OPA). The administration by the OP of the funds received from FAO shall be carried out under its own financial regulations, rules and procedures, which shall provide adequate controls to ensure that the funds received, are properly administered and expended. The Operational Partner shall maintain the account in accordance with generally accepted accounting standards.

Financial Records. FAO shall maintain a separate account in United States dollars for the project's GEF resources showing all income and expenditures. FAO shall administer the project in accordance with its regulations, rules and directives. The OP shall maintain books and records that are accurate, complete and up-to-date. The OP's books and records will clearly identify all Fund Transfers received by the OP as well as disbursements made by the OP under the OPA, including the amount of any unspent funds and interest accrued.

Financial Reports. The BH shall prepare quarterly project expenditure accounts and final accounts for the project, showing amount budgeted for the year, amount expended since the beginning of the year, and separately, the un-liquidated obligations as follows: (i) Details of project expenditures on outcome-by-outcome basis, reported in line with Project Budget as at 30 June and 31 December each year; (ii) Final accounts on completion of the Project on a component-by-component and outcome-by-outcome basis, reported in line with the Project Budget; (iii) A final statement of account in line with FAO Oracle Project budget codes, reflecting actual final expenditures under the Project, when all obligations have been liquidated.
The OP will prepare the financial reports in accordance with terms, conditions, formats and requirements of FAO and the provisions of the signed OPA. The BH will review and approve request for funds and financial reports of the OP. The subsequent instalments can be released only based on the BH confirmation that all expenditures are eligible and all OPA requirements are fulfilled to the satisfaction of FAO. The BH will withhold any payment due to the OP in case of non-compliance with the reporting obligations detailed in the OPA.
Financial reports for submission to the donor (GEF) will include both FAO- and OP-managed resources, will be prepared in accordance with the provisions in the GEF Financial Procedures Agreement and submitted by the FAO Finance Division.

Responsibility for Cost Overruns. As regards resources directly managed by FAO, the BH shall utilize the GEF project funds in strict compliance with the Project Budget (Appendix A2) and the

approved AWP/Bs. The BH can make variations provided that the total allocated for each budgeted project component is not exceeded and the reallocation of funds does not impact the achievement of any project output as per the project Results Framework (Appendix A1). At least once a year, the BH will submit a budget revision for approval of the LTO and the FAO/GEF Coordination Unit through FPMIS. Cost overruns shall be the sole responsibility of the BH.
As regards resources managed by the OP, the OP shall utilize the funds received from FAO in strict compliance with provisions of the signed OPA and its Annexes, including approved work plan and budget. The OP can make variations not exceeding 10 percent on any budget heading. Any variations above 10 percent on any budget heading that may be necessary will be subject to prior consultations with and approval by FAO.
Under no circumstances can expenditures exceed the approved total project budget or be approved beyond the NTE date of the OPA and/or the project. Any over-expenditure is the responsibility of the BH.
Audit. The project shall be subject to the internal and external auditing procedures provided for in FAO financial regulations, rules and directives and in keeping with the Financial Procedures Agreement between the GEF Trustee and FAO.

The audit regime at FAO consists of an external audit provided by the Auditor-General (or persons exercising an equivalent function) of a member nation appointed by the Governing Bodies of the Organization and reporting directly to them, and an internal audit function headed by the FAO Inspector-General who reports directly to the Director-General. This function operates as an integral part of the Organization under policies established by senior management, and furthermore has a reporting line to the governing bodies. Both functions are required under the Basic Texts of FAO which establish a framework for the terms of reference of each. Internal audits of imprest accounts, records, bank reconciliation and asset verification take place at FAO field and liaison offices on a cyclical basis. Specific provision for auditing the OP managed funds are included in the signed Operational Partners Agreement (OPA). During implementation, assurance activities are organized by FAO to determine whether the progress has been made and whether funds transferred to Operational Partners were used for their intended purpose, in accordance with the work plan and relevant rules and regulations. This may include, but is not limited to, monitoring missions, spot checks, quarterly progress and annual implementation reviews, and audits on the resources received from FAO.

Procurement. Procurement will follow OP rules and regulations for the procurement of supplies, equipment and services. The OP will draw up a procurement plan as part of the supporting documentation to each request for funds submitted to FAO. The plan will include a description of the goods, works, or services to be procured, estimated budget and source of funding, schedule of procurement activities and proposed method of procurement. In situations where exact information is not yet available, the procurement plan should at least contain reasonable projections that will be corrected as information becomes available.
The procurement plan shall be updated every quarter and submitted to FAO BH and LTO for clearance.

Annex L: FAO and Government Obligations

Not applicable

Annex M1: Background information for the hydrology of the Cambodia-Mekong Delta Aquifer

The CMDA covers large parts of Cambodia and Viet Nam's south and a range of its aquifer segments connect both countries. The following describes in detail climate conditions, surface hydrology and aquifer systems of the CMDA.

Climate Conditions

The CMDA area is characterized by an equatorial tropical climate. High temperatures and number of sunny days provide excellent conditions for tropical agriculture, with potentials for a wide diversity of crops and livestock. Rainfall in the CMDA fluctuates extensively during any given year, and with typically distinguished wet and the dry seasons (Pham et al., 2002). The wet season lasts from May to October and accounts for about 90 percent of the annual rainfall. Very little rainfall can be observed during the dry season, which lasts from ca. November to April (Long et al., 2003). The climate is monsoonal humid and tropical, with average temperatures of 24–30°C where typically the coolest month is January and the hottest month is May. However, the rainfall distribution across the CMDA area is strongly influenced by the topography and the two monsoons; therefore, the spatial pattern of rainfall varies throughout the area. The highest rainfall occurs in the southwest along coastal areas, with annual amounts ranging from 2 000 mm to 3 400 mm (Sok and Choup, 2017). In this region, approximately 80 percent of the annual rainfall is received during the Southwest Monsoon season. The second highest rainfall occurs in the northeast plateau area where the annual rainfall amounts range from 1 800 mm to over 2 200 mm. The region with the lowest rainfall stretches from the northwest to the southeast and includes the Tonle Sap (the lake and river system between Siem Reap and Pursat), which receives an annual rainfall of less than 1 400 mm. The annual precipitation is between 1 400 and 2 200 mm/year, with a subtropical climate pattern (Sok and Choup, 2017). Estimated annual potential evaporation ranges from 800 to 1800 mm with the lowest evaporation in October and the highest in March. The mean monthly relative humidity varies from a low of around 74 percent in the dry to 83 percent in the wet season (White, 2002). The marked seasonality is also reflected in the volume of Cambodia's Tonle Sap lake.

Surface hydrology

The Mekong river flow is distinguished by two seasons: a high season, and a low season. In upstream areas, the high season lasts from June to November, and the low season from December to May. The Tonle Sap (or 'Great Lake') plays an important role in regulating the flow for the area downstream of Phnom Penh. During the high season, the Great Lake stores inflow water from the Mekong River; this reverses the River flow during the low season. Due to this situation, the flow during high season may be reduced and the flow during the low season may be increased in areas downstream of Phnom Penh. The flow regulation by the Tonle Sap can help to decelerate annual inundation and lengthen flooding periods, and given its reservoir function, also considerably increase flows during the low season. Based on the statistics, the flow downstream of Phnom Penh during February–May decreases substantially, with the discharge of 2 000–5 000 m^3/s in April (lowest), and the average discharge is of 2 380 m^3/h, which is even as low as 2 000 m^3/s for the lowest year on record (Long et al., 2003). The mean annual water discharge of the

Mekong is 15 000m^3/s at Phnom Penh and can reach 50 000m^3/s in the rainy season. Great volumes of sediment (160 million tons/year, mostly composed of silt, clay and sand) are transported to the South China Sea and the delta consists almost entirely of recent alluvial soils of marine and fluvial origin (Nguyen et al., 2000). More recently, sediment levels have dropped due to the development of large reservoirs in upstream reaches of the Mekong, which have trapped substantial portions of sediment. Groundwater varies in response to these complex hydrological processes (Pham et al., 2002).

Viet Nam's Mekong Delta river system consists of the natural river systems and an extensive manmade canal system (Figure 22). The main natural river systems are the Tien river and Hau river system; the Vam Co river system; and Cai Lon and Cai Be river system as shown in Figure 22.

- Tien and Hau rivers transfer large amounts of water with a total annual flow of 325.41 billion m^3 in Tan Chau and 82.43 billion m^3 in Chau Doc stations; the flow rate on the Tien River / Hau River is 80/20. Both the Tien river and Hau river are wide and deep, with the average width of about 1000-1500 m and an average depth of 10-20 m (and locations with depths of over 40 m).
- Vam Co river system consists of two branches Vam Co Dong and Vam Co Tay, are derived from Cambodia, flows east through the Mekong Delta.
- The Cai Lon and Cai Be are tidal rivers, derived from the center of the Ca Mau Peninsula and flow to the sea through the Cai Lon river mouth. The estuary is very wide but not deep.

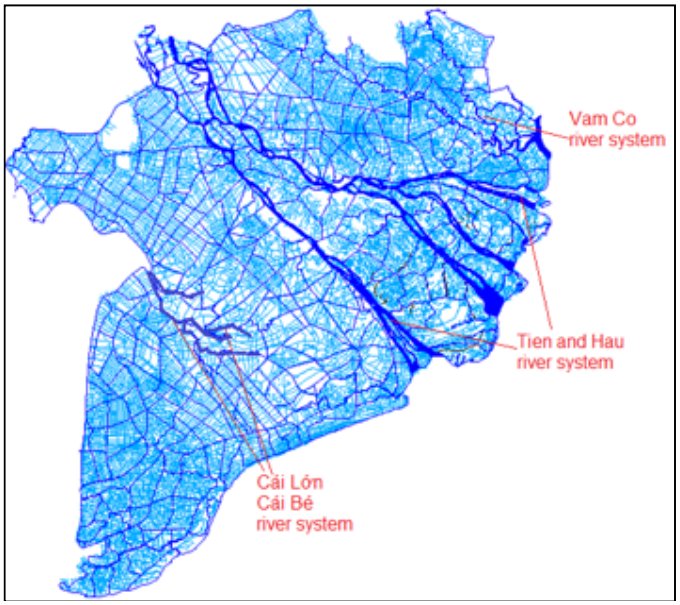


FIGURE 22. MEKONG DELTA RIVER SYSTEM

The system of manmade canals in the Mekong delta was developed primarily during the past century, with the primary purpose of developing agriculture and transportation. Until now, the canal system has developed into a dense network of major, primary and secondary canals. The primary and secondary canal systems have a high density, with some 80-10 m/ha, and a total of 30 000-40 000 km of canals in all the Mekong Delta.

The large seasonal variation in climate results in an equally large variation in flow of the Mekong River. At the peak of flows, large parts of the delta flood, particularly the northern areas. Depth

and duration of flooding vary according to location and intensity of monsoon rains, but can be as deep as 3 m and last for 4-5 months in low-lying areas. Flows are lowest in April, and at this time seawater is able to move upstream to inundate approximately one third of the entire delta. Even in the wet season, saltwater inundation occurs during high tides in parts of the south-east.

Geology

Cambodia forms part of a stable continental block with a basement of Palaeozoic and older rocks. These form numerous isolated outcrops in the uplands surrounding the central plains, but in lower-lying areas are covered mainly by Mesozoic deposits of the Khorat Basin which extends over a large part of Cambodia and Thailand was shown in Figure 23 (McDougall, 2009).

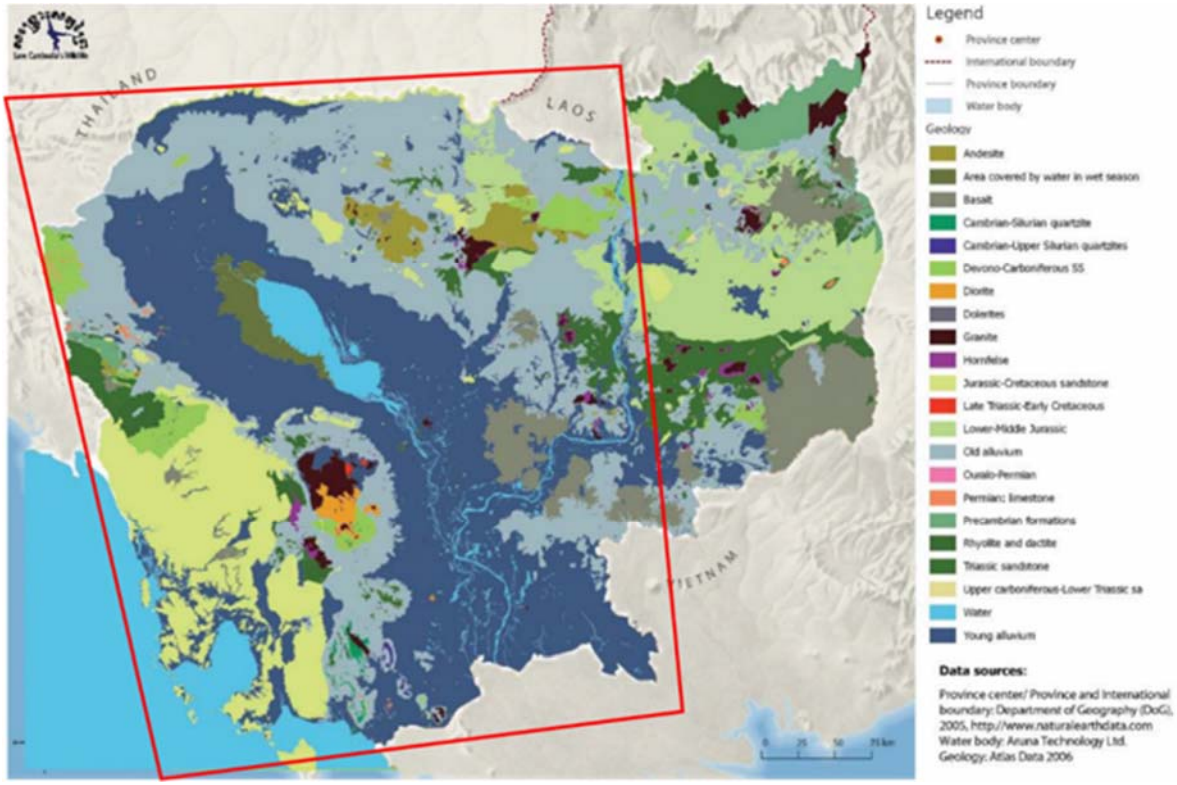


FIGURE 23: SIMPLIFIED GEOLOGICAL MAP OF CAMBODIA (ODC, 2006)

Based on landforms, geology and occurrence of groundwater, Cambodia can be divided into three regions, as shown in Figure 1, i.e.:

- the *Cambodian Mekong Delta Zone* accounting for 35 839 km^2 and including the Provinces of Kampong Cham, Kampong Chhnang, Kampong Speu, Kampong Thom, Svay Rieng, Prey Veng, Kandal, and Takeo, and also Phnom Penh Capital,
- the *Tonle Sap Lake Zone* accounting for 81 663 km^2 and including the Provinces of Battambang, Pailin, Preah Vihear, Pursat, Siem Reap, Otdor Meanchey, Bantey Meanchey, and Kampong Thom, and
- the *Coastal Plain* of Southwestern Cambodia accounting for 18 046 km^2 and including Kampot, Kep, Koh Kong and Sihanouk Ville province.

The Tonle Sap lake Zone and Cambodian Mekong Delta Zone are dominated by extensive Alluvium aquifers consisting of young and old Alluvium, which play an important role in groundwater resource in these two zones. Along the Tonle Sap, Bassac, and Mekong Rivers, it consists of sedimentary, metamorphic, and igneous units. Generally, alluvium consists of sandy silt in the upper part and clayey silt in the lower part. The younger alluvium is situated under the

Mekong and Tonle Sap Lake floodplains (Peng and Pin, 2002), which are up to 10 m thick and silty with poor aquifers and low water quality (arsenic, iron) while "old alluvium" controls multiple aquifers and produces high quality groundwater. About 30 percent of this groundwater was to be obtained around Phnom Penh. No artesian aquifers were found, the area is underlain at depths ranging from 18m to 80m by hard crystalline rock.

Geologically, the Coastal Zone is dominated by Jurassic Cretaceous formations, which include clay stone, shale, sandstone and conglomerate. The recent alluvium covers in as a second layer most of this zone.

The hydrogeological aquifer area by calculation based on geological map compiled in 2001-2003 has been summarized and put in Table 18.

TABLE 18. HYDROGEOLOGICAL AQUIFER AREA IN CAMBODIA (TOCH SOPHON, 2014)

Aquifer Zone	Total area (km^2)	Rock formation type				Other formation	
		Quaternary alluvium (area/thickness, km^2)					
		Alluvium	Basalt	Post Triassic sandstone and conglomerate	Other igneous rock	Limestone	Triassic metamorphic rock
Coastal	18047	4940	38	12161	133	6	276
Tonle Sap	81703	70476	684	3323	2324	137	1057
Cambodia Mekong Delta	36049	30196	1857	288	692	16	811
Total	**181282**	**119722**	**8733**	**25449**	**6437**	**295**	**9781**

Moving south, Viet Nam's Mekong Delta consists of intrusive, extrusive rocks and sedimentary formations of Devon to Quaternary age. They were formed in different tectonic phases. The intrusive and extrusive rocks act as a basement, while the sedimentary formations are the cover layers.

The sedimentary formations in the Viet Nam Mekong Delta consist of middle-upper Miocene (N12-3), upper Miocene (N_1^3), lower Pliocene (N_2^1), middle Pliocene (N_2^2), lower Pleistocene (Q_1^1), middle- upper Pleistocene (Q_1^{2-3}), upper Pleistocene (Q_1^3), lower- middle Holocene (Q_2^{1-2}), middle-upper Holocene (Q_2^{2-3}), and upper Holocene (Q_2^3) aquifers. Each formation is subdivided into units with sediments of different origins. Generally, each formation has been divided into two parts. The upper part is composed of a low permeable silt, clay or silty clay. A lower rather permeable part consists of fine to coarse sand, gravel, and pebble.

Aquifer system

Cambodian Mekong Delta Aquifer

The Cambodian Mekong Delta Aquifer Zone is located entirely in the Mekong Delta part of Cambodia extending from south of Kratie in the north, the border with Viet Nam to the south, to the east and northeast by the Stung Chhlong and the Tonle Vaico River basins, to the west the Stung Prek Thnot River basin. To the north, the Mekong Delta basin Group is delimited by the Tonle Sap River Basin. The most land area of central part covering of this river basin is within the Mekong flood plain with land elevation varying between 2 to some 20 m. With its many lakes and swampy areas, this region is subject to regular flooding from several months to six months per years.

Among the 678 well records, 455 well records belong to alluvium aquifer, 184 well records are in basalt aquifer, 1 well record is in Post Triassic formation aquifer, 28 well records are in other

igneous rock aquifer and 10 records are in Triassic formation and metamorphic aquifer. Among the collected 678 well records 10.47 percent are non-productive. In the alluvium formation, 12.9 percent are non-productive while in the basalt aquifer 5.43 percent are non-productive. Only one well record has been collected for the Post Triassic formation aquifer. In other igneous rock aquifer out of the total 28 well records, of which 5 wells are non-productive. The value of hydraulic parameters in this zone has been summarized in Table 4.

TABLE 19. RANGE VALUE OF HYDRAULIC PARAMETERS OF EACH GEOLOGICAL AQUIFER TYPE IN CAMBODIAN MEKONG DELTA AQUIFER

Geological Formation Type	Quaternary alluvium			Other formation		
	Alluvium	Basalt	Post Triassic sandstone and conglomerate	Other igneous rock	Limestone	Triassic metamorphic rock
Range of Yield in m^3/h	0.8-10	1-7.2	1	1-6.5	-	1.1-6
Range of Specific Capacity in $m^3/d/m$	0.25-60	0.26-72	0	0.27-45	-	0.41-14.40
Range of Transmissivity in m^2/d	0.35-83.10	0.37- 99.72	1	0.38-62.33	-	0.57-19.94
Range of Conductivity in m/d	0.05-10.39	0.05-12.47	0	0.05-7.79	-	0.07-2.49

Tonle Sap Lake Aquifer

Geologically, the Tonle Sap river basin group is dominated by the quaternary sediment formation consisting of old alluvium at higher elevation, approximately above 30m, and extending everywhere up to the foot hills of the surrounding mountain ranges (Cardamom and the Dangrek Chain of Mountains), overlayed by recent alluvium in the area below until the permanent lake area. The two national roads (RN6 and RN5) mark the boundary of the annual flood. The topography of the Lake and its surrounding area is very flat. Few investigations exist on geology and geohydrology in the Tonle Sap Lake areas. Among the total 421 collected well records 23 percent are non-productive. If distinguished between aquifer types, 25 percent of wells in the alluvium aquifer, 22 percent in Post Triassic the formation aquifer, 25 percent of the other igneous rock aquifers, and less than 1 percent of Triassic formation and metamorphic aquifers are non-productive. Hydraulic parameters for this zone are shown in Table 20.

TABLE 20. RANGE VALUES OF HYDRAULIC PARAMETERS OF EACH GEOLOGICAL AQUIFER TYPE IN TONLE SAP LAKE AQUIFER

Geological Formation Type	Quaternary alluvium			Other formation		
	Alluvium	Basalt	Post Triassic sandstone and conglomerate	Other igneous rock	Limestone	Triassic metamorphic rock
Range of Yield in m^3/h	1.1-9	3-6.5	1.5-7.2	1.5-6	-	1.5 - 5
Range of Specific Capacity in $m^3/d/m$	0.45-390	3.86-13	0.82-174	0.86-25.64	-	0.89-27.27
Range of Transmissivity in m^2/d	0.62-540.15	5.34- 18	1.13-240.99	1.19-35.51	-	1.23-37.77
Range of Conductivity in m/d	0.08-67.52	0.67-2.25	0.14-30.12	0.15-4.44	-	0.15-4.72

Cambodia's Coastal Aquifer

The aquifer of the Coastal Zone shows that the dominant geology formation is of this region is Jurassic Cretaceous formation (in the class of Post Triassic sandstone and conglomerate) and the recent alluvium lay on the valley and costal area. The well records from WellMap shows 396 records located in this zone. 390 well records fall into alluvium area and only 6 well records located in the type of rock formation Post Triassic Sandstone and Conglomerate. All these well records locate in the Alluvium formation type and have a range of specific capacity from 0.2742 m^3/day/m to 46.4286 m^3/day/m, a range of transmissivity from 0.3797 m^2/day to 64.3036 m^2/day and a range of conductivity from 0.0475 m/day to 8.0379 m/day.

Viet Nam's Mekong Delta

The aquifer system for the wider Mekong Delta have been investigated more extensively than the Cambodian side. Basically, the aquifer system in Mekong Delta has an artesian basin structure. The deepest area of the basement is located below the Tien and Hau Rivers and rises to the NE, N and NW borders. Figure 24 illustrated the layout of the two cross sections and Figure 25 and Figure 26 provides an overview of the spatial distribution and interconnection of aquifer system of the Deltas' subsurface.

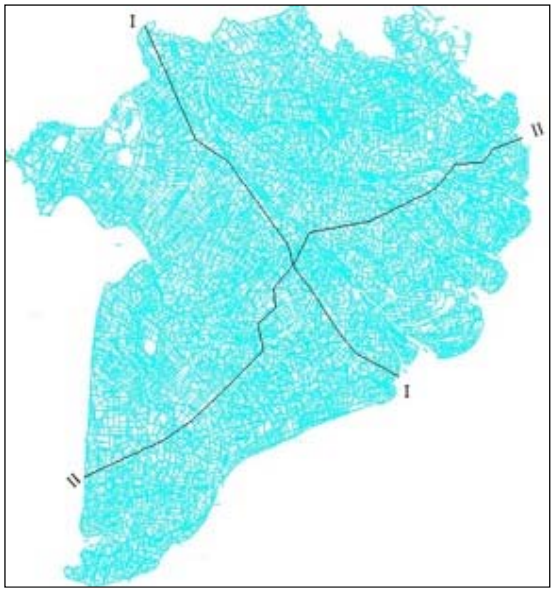


FIGURE 24. CROSS-SECTION LAYOUT (VUONG B.T. (2014))

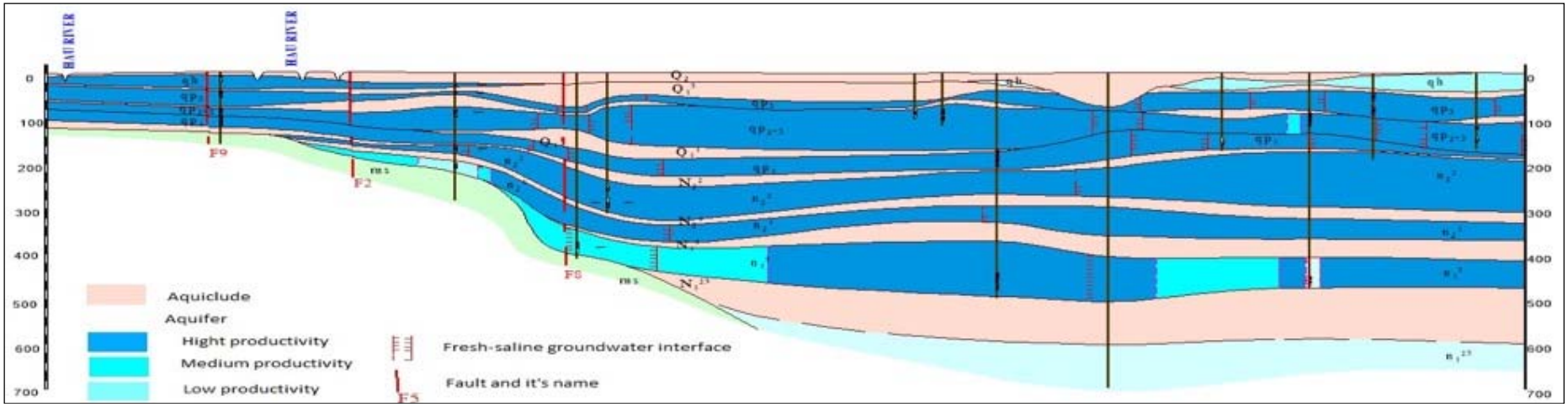


FIGURE 25. HYDROGEOLOGICAL CROSS-SECTION I-I (VUONG B.T. (2014))

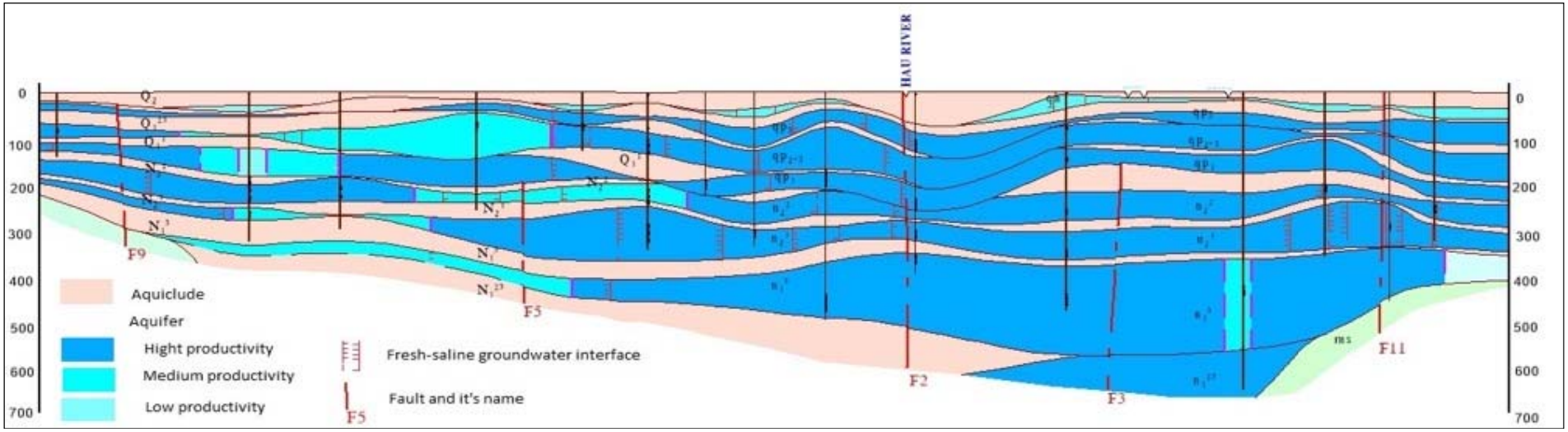


FIGURE 26. HYDROGEOLOGICAL CROSS-SECTION II-II (VUONG B.T. (2014))

A brief characterization of the aquifers and their composition is summarized below.
Holocene aquifer, qh: The Holocene aquifer extends over an area of 17 676km^2, is absent along Viet Nam -Cambodia boundary as well as at northern west part of the Mekong Delta. The depth to the top of the aquifer varies from 0.00m to 61.50m; the depth to the bottom of the aquifer ranges from 2.80m to 89.00m; the average thickness is 15.48m. The groundwater levels are generally between 0.5 to 3.0 m above sea-level. The area with fresh groundwater (TDS<1g/l) is 2 889km^2 and that of saline groundwater is 14 788km^2. The amount of groundwater abstracted on 2010 is 17 851m^3/day. To the northeast, this aquifer extends through Ho Chi Minh City. In the Ho Chi Minh City, the qh aquifer has a distribution area of 196.2 km^2, of which the area of fresh groundwater (TDS< 1.5 g/l) is 146.2km^2 and that of saline groundwater (M≥1.5g / l) is 50.0km^2. Due to the small distribution area, the thickness is thin; low productivity, poor quality water; directly affected by surface water, the exploitation capacity of this aquifer is negligible. There is insufficient data to determine if this aquifer extends into Cambodia and how far it extends.

Upper Pleistocene aquifer, qp3: The Upper Pleistocene aquifer distributes widely across an area of 39 468km^2. Its depth to the top of the aquifer varies from 0.00m to 115.40m; the depth to the bottom of the aquifer ranges from 11.50m to 154.00m; the average thickness is 29.14m. The permeability varies from 0.22m/day to 65.82 m/day and the average head above the top of the aquifer is 45.14m. The groundwater levels are between -6.36m and 0.99m above sea-level. The area with fresh groundwater is 10 494km^2 and that of saline groundwater is 28 974km^2. The amount of groundwater abstracted by the year of 2010 is 114.945m^3/day. To the northeast, this aquifer extends to Ho Chi Minh City where it covers an area of 1 224.6 km^2 with an average depth of 13.3m; the depth to the bottom of the aquifer ranges from 5.6m to 78.0m. The average thickness of the aquifer is 22.6m. The fresh groundwater area is 845.5 km^2, that of the saline groundwater is 371.1 km^2. Groundwater in this aquifer is being exploited for household water supply by production wells with small capacity. There is not much data to determine if this aquifer extends to even the Cambodian side.

Upper - Middle Pleistocene aquifer, qp2-3: The Upper-Middle Pleistocene aquifer covers an area of 39 279km^2. The depth to the top of the aquifer varies from 9.70m to 178.00m; the depth to the bottom of the aquifer ranges from 24.50m to 207.00m; the average thickness is 41.45m. The permeability varies from 0.89m/day to 55.07m/day. The average head above the top of the aquifer varies from 10.47 to 21.49m. The area with fresh groundwater is 14 941km^2 and that of saline groundwater is 24 338km^2. The amount of groundwater abstracted by the year of 2010 is 997 514m^3/day. Aquifer qp2-3 extends to the northeast into Ho Chi Minh City where it covers an area of 1 399 km^2 of which 1 052 km^2 is fresh groundwater and 346.9 km^2 saline groundwater. At present, there are many industrial production wells in the aquifer besides small capacity exploiting wells. Groundwater level decline is particularly large in Binh Chanh and District 12.
Relevant for the transboundary perspective of groundwater is the assessment of 4 Provinces, namely Kampot, Takev, Prey Veng and Svay Rieng in Cambodia, which are contiguous to Kien Giang, An Giang, Dong Thap and Long An province of Viet Nam (Rasmussen and William Charles, 1977).

Kampot is one of the four provinces of Cambodia that border the sea. Khet Takev is a densely populated Province in the flood plain of the Bassac River bordering Viet Nam. Prey Veng locates in the delta and its land surface is a low-lying plain, on which the elevations range from 2m above sea level at the south to 13m above sea level at the north. Svay Rieng is the south-eastern Province of Cambodia, with a pronounced salient that extends into South Viet Nam. Elevations in this area are 1 to 3 m above sea level, and the land surface is underlain by Young Alluvium.

TABLE 21. SUMMARY OF THE DEPTH TO THE TOP AND TO THE BOTTOM OF THE AQUIFER QP2-3

Province in Viet Nam		Depth to the top of aquifer	Depth to the bottom of aquifer	Province in Cambodia	Depth to the top of aquifer	Depth to the bottom of aquifer
Kien Giang	Min	25.0	37.2	Kampot	No data	
	Max	150.0	171.0		No data	20
An Giang	Min	1.0	16.0	Takev	No data	20
	Max	166.0	188.0		No data	63
Dong Thap	Min	22.0	58.0	Prey Veng	30	No data
	Max	150.0	176.0		50	No data
Long An	Min	13.0	56.0	Svay Rieng	20	No data
	Max	123.0	144.0		60	78

Table 21 summarizes the depth to the top and bottom of aquifer qp_{2-3} in the provinces adjacent to the Viet Nam - Cambodia border and the depth to the roof and bottom of aquifer being exploited in the Khets of Cambodia. It is possible that the qp_{2-3} aquifer in Viet Nam's side extends across the Viet Nam -Cambodia border. However, to confirm it is necessary to have more drilling data for determining stratigraphy in both Viet Nam and Cambodia.

Lower Pleistocene aquifer, qp1: The Lower Pleistocene aquifer distributes across 39.340km^2 and is composed of lower Pleistocene sediments of alluvial (aQ11) and alluvial-marine origin (amQ11). The depth to the top of the aquifer varies from 62.00m to 221.00m while the depth to the bottom of the aquifer ranges from 69.50m to 298.00m, with an average thickness of 38.08m. The permeability varies from 0.76m/day to 53.28m/day. The average head above the top of the aquifer is 129.82m. The groundwater levels are between -7.37m and -0.04m below sea-level. The area with fresh groundwater is 13 647km^2 and that of saline groundwater is 25693km^2. The amount of groundwater abstracted by the year of 2010 is 130 077m^3/day. In the Ho Chi Minh City area, aquifer qp1 is distributed over an area of 1 380 km^2, with 1 117km^2 of fresh groundwater. At present, underground water is being exploited by many industrial production wells together with small capacity exploiting holes.
There is no log of wells more than 78m deep near the Viet Nam -Cambodia border, so it is not known whether this aquifer and deeper aquifers extend to Cambodia side or not

Middle Pliocene aquifer, n22: The middle Pliocene aquifer covers an area of 36 267km^2, of which 14 014km^2 are fresh groundwater. The depth of the top of the aquifer varies from 42.60m to 318.90m while the depth to the bottom of the aquifer ranges from 125.00m to 415.40m, with an average thickness of 51.33m. The permeability varies from 0.17 to 67.20m/day. The average head above the top of the aquifer is 195.09m. The groundwater levels are between -20.14m to -7m above sea-level. The amount of groundwater abstracted by the year of 2010 is 477 395m^3/day.
Also, this aquifer extends to in Ho Chi Minh City, where it covers an area of 1 394 km^2, of which 1 268 km^2 is fresh groundwater. This is considered the best aquifer for large-scale domestic water supply in Ho Chi Minh City. However, due to the improper arrangement of production wells (most of the wells are concentrated in districts 12, Hoc Mon and Binh Chanh), it has caused a serious decline in groundwater levels. There is no data to determine if this aquifer extends into Cambodia.

Lower Pliocene aquifer, n21: The Lower Pliocene aquifer covers an area of 34 546km^2, of which 16 269km^2 is fresh groundwater. The depth to the top of the aquifer varies from 134.00m to 432.20m, and the depth to the bottom of the aquifer ranges from 180.00m to 435.10m, with an average thickness of 53.78m. Its permeability varies from 1.05m/day to 48.14 m/day. The average head above the top of the aquifer is 240.92m. The groundwater levels are between -1.37m and -5.89m above sea-level. The amount of groundwater abstracted by the year of 2010 is 87 652m^3/day. The aquifer covers in Ho Chi Minh City and areas of 1 114 km^2 and contains only fresh groundwater.

This is a deep aquifer with great thickness and good water quality. At present, there are not many production wells in this aquifer. There is no data to determine if this aquifer extends into Cambodia.

Upper Miocene aquifer, n13: Upper Miocene aquifer distributes widely over an area of 39 468km^2, of which 16 269km^2 is fresh groundwater. The depth to the top of the aquifer varies from 215.00m to 444.00m, while the depth to the bottom of the aquifer ranges from 220.50m to 508.00m, with an average thickness of 58.79m. The permeability varies from 1.05m/day to 48.14 m/day. The average head above the top of the aquifer is 377.00m. The groundwater levels are between -7.77m and -1.97m above sea-level. The amount of groundwater abstracted by the year of 2010 is 87 652m^3/day. In the Ho Chi Minh City an area of 520 km^2 are covered by this aquifer. The fresh groundwater area is 482 km^2. No production wells exist in this aquifer. There is no data to determine if this aquifer extends into Cambodia.

Annex M2: Groundwater extraction

Two types of water are available in Cambodia: approximately 75 000 million m^3 of annual surface water runoff and 17 600 million m^3 of aquifer groundwater (Chamroeun and Sokuntheara, 2016). Groundwater accounts for approximately 62 percent of the total domestic water use in Cambodia (NISC and ADB, 2003). 53 percent of Cambodian households drink from groundwater sources in the dry season. No data are currently available for groundwater exploitation in Cambodia. Approximately 270 000 tube-wells with hand pumps are in use for drinking water purposes (Sok and Choup, 2017). However, dry season irrigation using groundwater is expected to increase in both Viet Nam and Cambodia (Eastham et al., 2008; Phuc, 2008; IDE Cambodia, 2009). Groundwater is accessed via dug wells, small-scale household tube-wells, or medium and large-scale central supply wells that were dug as part of the Rural Clean Water Supply Program (Stolpe, 2008; CERWASS, 2011).

The majority of wells are located in the Cambodian Mekong Delta Zone (48 831) and in the Tonle Sap Lake Zone (11 401), while the Coastal Zone records only 396 wells. The number of wells in alluvium aquifers (58 593) dominates across all zones, with 47 416 wells in the Cambodian Mekong Delta Zone, 10 887 wells in the Tonle Sap Lake Zone, and 390 wells in the Coastal Zone. Although data are limited it is estimated that approximately 100 000-270 000 tube (dug) wells with hand pumps have been installed for drinking water and irrigation purposes (Chamroeun and Sokuntheara, 2016).

Since 1960, the utilization of groundwater resources from the Cambodian Mekong Delta Aquifer for domestic and agricultural uses has increased. In the early 1960s, the Agricultural Area Development initiative of the USAID resulted in the excavation of approximately 1 100 wells with depths ranging from 2 to 209 m and a mean depth of 23 m. Subsequently, wells for water supply have been developed with the support of international organizations (e.g. UNICEF, OXFAM and World Vision) since the early 1980s. Approximately 31 000 wells with depths ranging from 32 to 38 m and yields ranging from 28.8 to 85.68 m^3/day (mean of about 60.72 m^3/day) were developed between 1983 and 2001 (Ministry of Planning, 2003). As of 2005, at least 100 000 wells were being developed or used for water supply in rural areas throughout the country. However, **approximately 20 percent of shallow wells dried up and are currently unavailable**. The borehole diameters and depths of wells were analyzed based on a database established by UNICEF and the Ministry of Water Resource and Meteorology (MOWRAM). The analyzed data involved 14 255 wells and identified that most borehole diameters range from 100 to 200 mm with a depth ranged of 25 to 37 m, see Table 22. The total groundwater usage in Cambodia is approximately 400 000 m^3/day (about 300 000 m^3/day for rural use and 60 000 m^3/day for urban use), see Figure 27.

TABLE 22. CHARACTERISTICS OF REGIONAL GROUNDWATER DEVELOPMENT WELLS IN CAMBODIA

Aquifer Zone	No. of wells tested	Well depth (m)		
		Mean	Maximum	Minimum
Coastal Zone	74	29.4	54	3
Tonle Sap Lake zone	684	29.55	82	6
Cambodian Mekong Delta Zone	2532	32.25	129	7

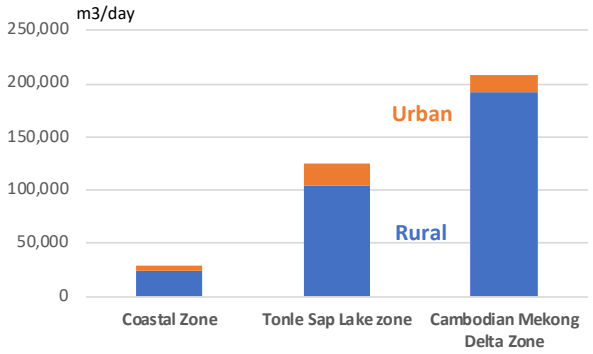


FIGURE 27: STATUS OF GROUNDWATER USE IN CAMBODIA (SOK AND CHOUP, 2017)

On the Viet Nam side of the CMDA 553.135 abstraction wells are in use and the amount of groundwater abstraction is 1 923 681 m^3/day Provinces with large number of abstraction wells are Bac Lieu (93 369), Kien Giang (93 130), Tra Vinh (88 833), and Soc Trang (80 069). Most abstraction wells have a capacity (yield) less than 200m^3/day. Most wells extract from aquifer qp_{2-3} (417 010 wells). Tra Vinh province has the highest density of 40 wells/km^2; followed by Bac Lieu province (36 wells / km^2) and HCMC and Can Thơ cities (35 well/km^2). In Ho Chi Minh City exist 342 657 groundwater exploitation wells.

Groundwater is mainly abstracted from aquifer qp_{2-3} (977 514 m^3/day) and aquifer n_2^2 (477 359 m^3/day). Groundwater is abstracted for domestic use (801 730 m^3/day or 41.7 percent), for agricultural production (769 619 m^3/day or 40.01 percent), and less for industrial production (352 332 m^3/day or 18.32 percent), see Table 23.

Ho Chi Minh City is currently exploiting 577 077 m^3/day of underground water. The most exploiting districts are District 12 (105 256 m^3/day), Hoc Mon district (100 580 m^3/day), Binh Chanh district (88 986 m^3/day). District 4 and Can Gio do not exploit groundwater (Cao Xuan Viet and et al., 2019[b]).

TABLE 23. AMOUNT OF GROUNDWATER ABSTRACTION PER PROVINCE IN TERM OF WELL CAPACITY, ON PURPOSE OF USE AND BY AQUIFER

No	Province	Amount of GW abstraction m^3/day	Amount of GW abstraction in term of well capacity of		Amount of GW abstraction on use purpose, m^3/day			Amount of GW abstraction per aquifer, m^3/day						
			Q>200 m^3/day	Q<200 m^3/day	Domestic	Agri	Indus.	qh	$_3$	qp_{2-3}	qp_1	n_2^2	n_2^1	n_1^3
1	An Giang	94.537	34.912	59.625	37.482	34.191	22.864	8.911	41.673	8.856	0	34.185	864	0
2	Bac Lieu	248.728	54.082	194.646	63.072	167.263	18.393	0	106	174.319	61.838	12.465	0	0
3	Ben Tre	17.986	12.660	5.327	11.872	1.905	4.210	2.059	1.926	541	0	0	10.161	3.300
4	Ca Mau	159.118	65.725	93.393	87.493	40.145	31.480	0	0	24.895	28.592	105.198	433	0
5	Can Thơ	188.844	96.501	92.343	101.398	42.530	44.916	0	0	146.872	0	41.972	0	0
6	Dong Thap	116.169	65.008	51.161	37.155	9.141	69.873	0	0	1.426	0	114.743	0	0
7	Hau Giang	62.544	7.480	55.063	31.548	25.395	5.600	0	11.982	43.234	7.328	0	0	0
8	Kien Giang	197.441	40.680	156.761	122.650	73.991	800	414	34.018	149.032	3.642	6.835	3.500	0
9	Long An	195.554	120.636	74.918	96.663	31.800	67.091	0	0	0	11.491	144.585	35.609	3.869
10	Soc Trang	244.850	62.140	182.710	73.190	140.480	31.180	1.869	25.240	189.241	17.186	0	0	11.314
11	Tien Giang	140.664	28.589	112.075	59.596	39.719	41.349	0	0	0	0	17.376	23.536	99.752
12	Tra Vinh	224.773	26.290	198.483	65.330	150.293	9.150	4.598	0	220.175	0	0	0	0
13	Vinh Long	32.473	5.426	27.047	14.281	12.766	5.426	0	0	18.923	0	0	13.550	0
Sum		**1.923.681**	**620.129**	**1.303.552**	**801.730**	**769.619**	**352.332**	**17.851**	**114.945**	**977.514**	**130.077**	**477.359**	**87.652**	**118.235**

Safe exploitation reserves of groundwater resources

Secure exploitable groundwater reserves of a groundwater basin or aquifer system are defined as the amount of water that can be exploited from it without producing any undesired effects.

TABLE 24: GROUNDWATER RECHARGE IN CAMBODIA MEKONG DELTA

Zone	Recharge area (km^2)	Annual rainfall (mm)	Annual recharge (Million m^3/year)
Tonle Sap Lake zone	65 600	1 397	4 582.2
Delta zone in Cambodia	23 849	1 470	1 752.9
Cambodia Mekong Delta Aquifer	89 450		6 335.1

The groundwater recharge in Cambodia's part of the CMDA (Table 24) estimates the annual recharge of the CMDA as 4 582 Million m^3/year in the Tonle Sap Lake zone and 1 753 Million m^3/year in the Cambodian Delta zone, which results in a total recharge of 6 335 Million m^3/year for the Cambodian side of the CMDA. Table 25 shows the secure exploitable groundwater reserve index of approximately 10 percent for the Tonle Sap Lake zone and 20 percent for the Cambodian Delta zone, which results in 15 percent as the overall average.

TABLE 25. THE SECURE EXPLOITABLE GROUNDWATER RESERVE INDEX IN CAMBODIA MEKONG DELTA

Zone	Annual recharge (Million m^3/year)	Total abstraction (Million m^3/year)	Secure exploitable groundwater reserve Index (percent)
Tonle Sap Lake zone	4 582.19	467.33	10.2%
Delta zone in Cambodia	1 752.93	349.26	19.9%
Cambodia Mekong Delta Aquifer	6 335.12	816.59	15.1%

In January 1996, a study funded by the Government of Japan aiming at new groundwater supply for Phnom Penh municipality and rural areas found few artesian aquifers as the area being underlain at depths ranging from 18m to 80m by hard crystalline rock. The best well yielded 200 l/min, and the average of seven production wells was 80 l/min.

Data for Viet Nam groundwater exploitation reserves allows for distinguishing between the natural *static* and the natural *dynamic* reserves. The "natural static reserves" is applied to the volume of groundwater contained in the pores and cracks of an aquifer. In unconfined aquifer, the natural static reserve consists of only one component that is natural gravity static reserve. In confined aquifer, in addition to the natural static gravity reserve, there is also the natural elastic static reserve component. The "natural elastic static reserve" is defined as the volume of water which can be withdrawn from an aquifer by lowering of the water table.

The fresh groundwater exploitation reserve is estimated at 22 513 989 m^3/day, of which the natural gravity static reserve is 21 283 182 m^3/day and the natural elastic static reserve is 1 229 807m^3/day. In the Ho Chi Minh City are, the natural static reserve (consisting of the natural gravity static reserve and natural elastic static reserves) of the fresh groundwater was assessed to be 2 415 395 m^3/day. Assuming that the safe fresh groundwater exploitation reserve is equal to 20 percent of the fresh groundwater exploitation reserve and after subtracting the amount of fresh groundwater abstraction of 1 905 782 m^3/day in 2010, the remained safe fresh groundwater exploitation reserve is 2 596 815 m^3/day. The safe fresh groundwater exploitation reserve of the Ho Chi Minh City area is estimated at 1 969 066 m^3/day.

Table 26 shows that the aquifer n_2^1 has the highest fresh groundwater exploitation reserve (925 172 m^3/day) while aquifer qp_{2-3} has been overexploited by 89 186 m^3/day and is no longer capable of exploitation. This aquifer reaches into Cambodia especially into the Provinces Prey Veng and Svay Rieng. **Continued over-exploitation of this aquifer on Viet Nam's side will certainly affect the Cambodian side**.

TABLE 26. THE REMAINED SAFE FRESH GROUNDWATER EXPLOITATION RESERVE PER AQUIFER

Aquifer	The groundwater exploitation reserve, m^3/day	The safe fresh groundwater exploitation reserve, m^3/day	The amount of fresh groundwater exploitation in 2010, m^3/day	The remained safe fresh groundwater exploitation reserve, m^3/day
qh			17 851	
qp_3	2 002 106	400 421	114 945	285 476
qp_{2-3}	4 441 642	888 328	977 514	**-89 186**
qp_1	3 602 421	720 484	130 077	590 407
n_2^2	4 398 655	879 731	477 359	402 372
n_2^1	5.064 118	1 012 824	87 652	925 172
n_1^3	3 004 047	600 809	118 235	482 574
Sum	22 512 989	4 502 597	1 905 782	2 596 815

Groundwater levels of existing wells have been surveyed since February 1997. These monthly measurements continued until November 1997. Twenty-six wells were selected for monthly monitoring. The results of these groundwater level measurements show values of 1.7 to 2.25 meters for dug wells and 4.75 to 5.5 meters for drilled wells. The lowest groundwater levels were observed in January to July 1997 while maximum levels occurred between October-November 1997. The groundwater levels along the Mekong and Bassac River show a steep rise from June-July 1997. It is presumed that those groundwater levels are influenced by the water level changes of the rivers.

Groundwater level

Monitoring data for Viet Nam's side of the aquifers indicate a clear trend of decline in groundwater levels. In the Holocene aquifer (qh) the rate of decline is about 0.064 m/year, see Figure 28. In Ho Chi Minh City, the groundwater level of this aquifer has only decreased in Binh Chanh district (0.34m/year).

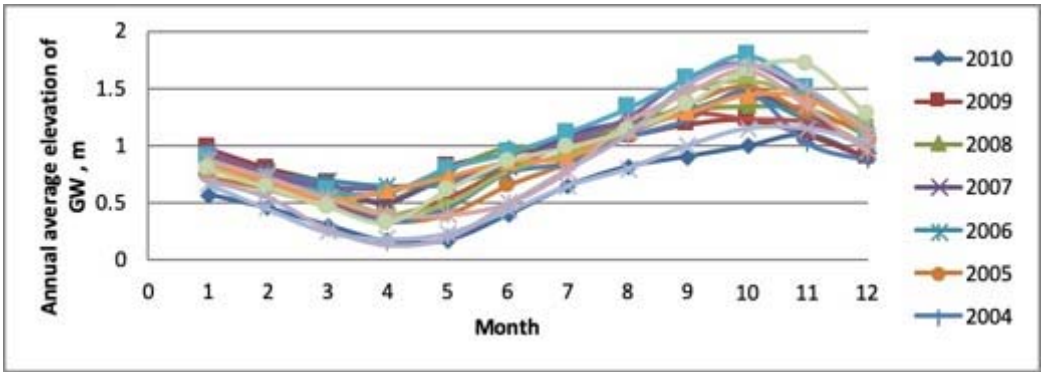


FIGURE 28. THE ANNUAL AVERAGE WATER LEVEL IN THE PERIOD 1995-2010, THE AQUIFER QH (CREATED BY AUTHORS)

The groundwater levels of the Upper Pleistocene aquifer (qp_3) declined across all observed boreholes decreases (Figure 29). The decline rate of the average groundwater level is about 0.15 m/year although in Can Thơ and Tra Vinh groundwater levels declined by 0.27 to 0.39 m/year. In the Ho Chi Minh City, groundwater levels in this aquifer have also decreased, particularly in Binh Chanh district (0.21 cm/year), which could be exacerbated by groundwater extraction in Long An province.

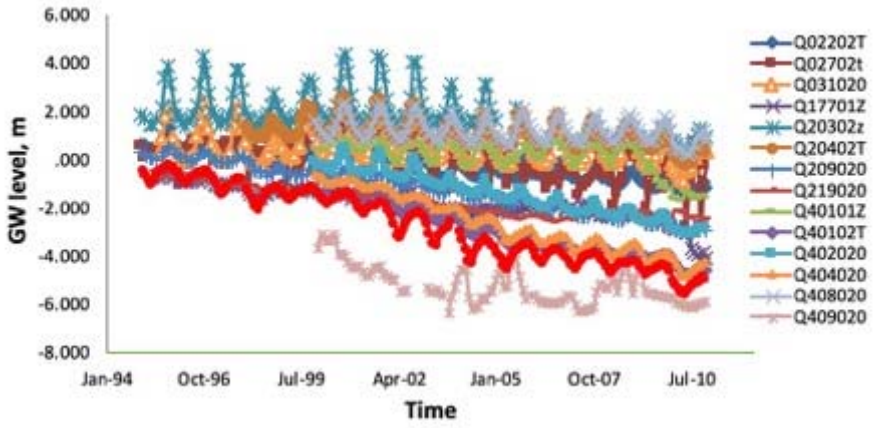


FIGURE 29. GROUNDWATER LEVELS AT MONITORING BOREHOLES IN AQUIFER QP_3 (CREATED BY AUTHORS)

In the Upper-middle Pleistocene aquifer (qp_{2-3}) groundwater levels decreased at all observed boreholes (Figure 30). The annual decline rate is about 0.30m/year, with higher rates in Kien Giang and Tra Vinh (0.37 to 0.40 m/year) and Soc Trang and Ca Mau (0.34 to 0.44 m/year). In the Ho Chi Minh City area groundwater levels of this aquifer declined between 2003 and 2016 by up to 0.39 m/year (District No12).

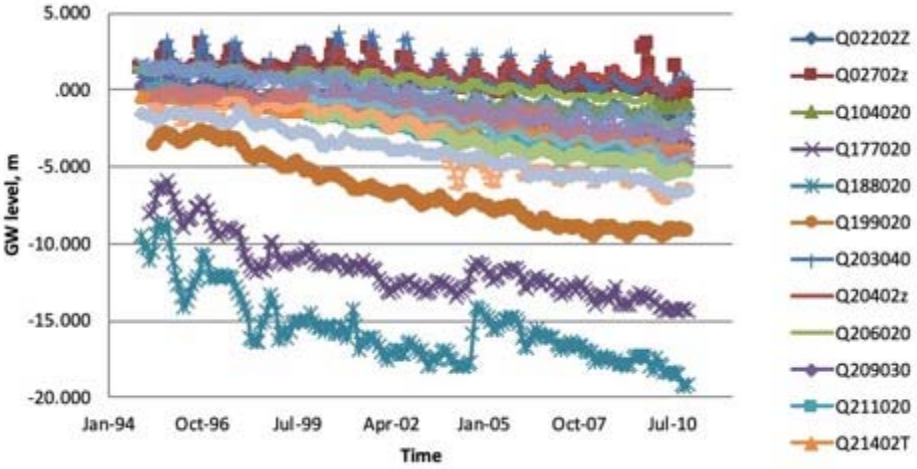


FIGURE 30. GROUNDWATER LEVELS AT MONITORING BOREHOLES IN AQUIFER QP_{2-3} (CREATED BY AUTHORS)

In the Lower Pleistocene aquifer (qp_1) groundwater levels dropped across all observed boreholes (Figure 31). The average rate of the annual average groundwater level per year is about 0.285m. In Hau Giang and Long An provinces rate of decline was 0.33 to 0.40m/year, in the Kien Giang area 0.37m/year, and in Soc Trang province 0.44m/year. In the Ca Mau province, average groundwater level dropped by an alarming 0.93m/year. In Ho Chi Minh City the rate of decline was up to 0.12 m/year (Cao Xuan Viet et al., 2019[a]).

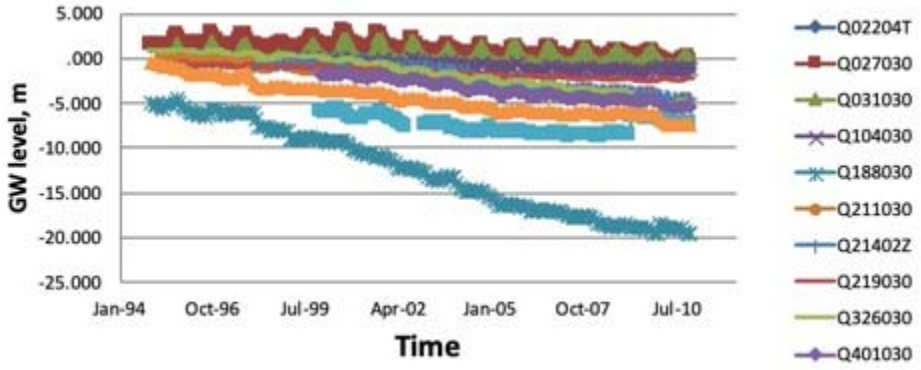


FIGURE 31. GROUNDWATER LEVELS AT MONITORING BOREHOLES IN AQUIFER QP_1 (CREATED BY AUTHORS)

Also the Middle Pliocene aquifer (n_2^2) experienced declining groundwater levels (Figure 32) with an average rate of 0.434m per year. In Tra Vinh province, the decline rate ranged between 0.51 and 0.58 m/year while the highest decline rate was in Ca Mau province with 0.62 to 0.89 m/year. In the Ho Chi Minh City area, groundwater levels of this aquifer declined by up to 0.78 m/year (Binh Chanh district).

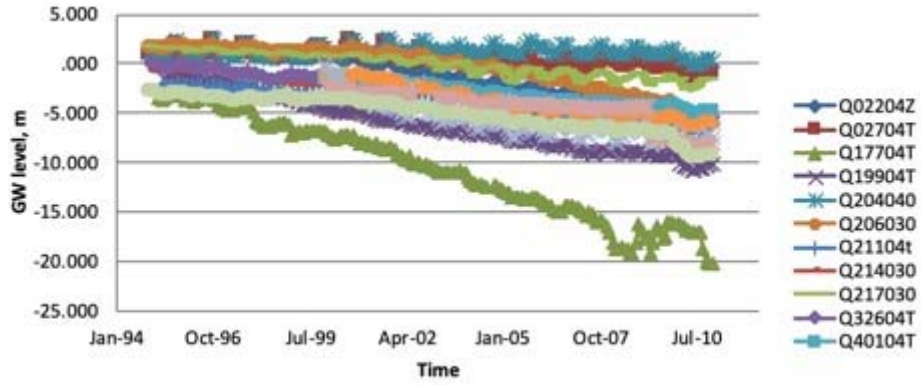


FIGURE 32. GROUNDWATER LEVELS AT MONITORING BOREHOLES IN AQUIFER N_2^2 (CREATED BY AUTHORS)

The groundwater decline was also observed for the Lower Pliocene aquifer (n_2^1) where the annual average reduction rate of groundwater level was around 0.365m. (Figure 33). In Long An and Ca Mau provinces, groundwater levels dropped sharply from 7.39 to 12.16m with an annual decline rate of 0.49 to 0.81m/year. Data for the Ho Chi Minh City area is very limited and indicates an annual decline of 0.26 m/year.

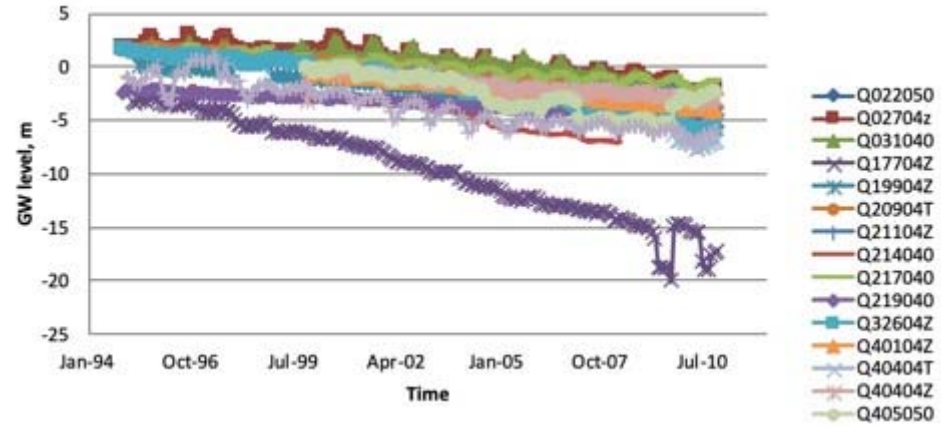


FIGURE 33. GROUNDWATER LEVELS AT MONITORING BOREHOLES IN AQUIFER N_2^1 (CREATED BY AUTHORS)

The Upper Miocene aquifer n_1^3 decreased at an average rate of 0.266m per year (Figure 34). The provinces with the strongest drop in water level are Hau Giang and Can Thơ (0.34 ÷ 0.52 m/year). In Ho Chi Minh City groundwater levels of this aquifer declined in Binh Chanh district between 2003 and 2016 at a rate of 1.11 m/year. No groundwater monitoring data is available for other districts (Cao Xuan Viet et al., 2019[a]).

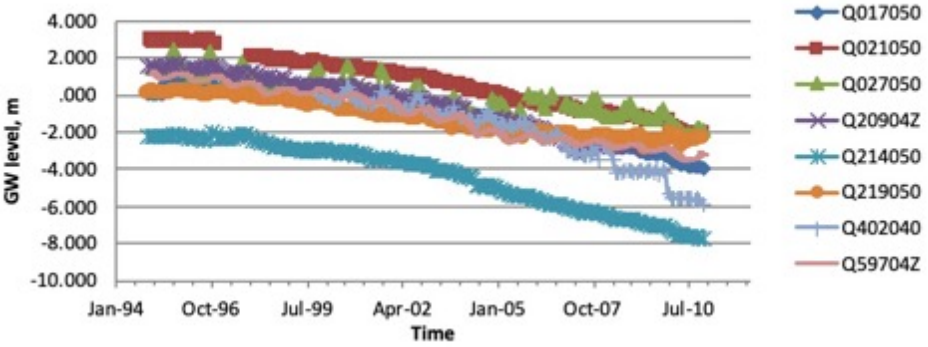


FIGURE 34. GROUNDWATER LEVELS AT MONITORING BOREHOLES IN AQUIFER N_1^3 (CREATED BY AUTHORS)

Annex M3: Land subsidence

Land subsidence is one of the major problems related to the over-extraction of groundwater. Land subsidence is especially of concern for aquifers of unconsolidated sediments, as a decrease in groundwater level reduces pore water pressure and in turn induces the compaction of unconsolidated sediment layers. The most imminent threat from land subsidence in Cambodia has been recorded for Siem Reap.

Siem Reap town is one of the fastest growing cities in Cambodia particularly fuelled by the tourism industry. Population of Siem Reap has grown from about 10 000 to 117 000 in 2000, to 146 000 in 2006 and is expected to grow up to about 240 000 in 2020. Due to the fast growth, water consumption in the area has increased exponentially during the last 20 years. Consequently, national agencies in charge of water resource management, particularly the Department of Water Management of the APSARA authorities face great challenges as all water supplies in the area are almost exclusively from groundwater (both in Siem Reap urban areas as in the villages in the Angkor park). At the moment, 16 000 m^3/day are pumped from wells south of West Baay while 18 000 m^3/day are pumped by private users in Siem Reap city. All the temples are built on sand layers. Their stability depends on the degree of water saturation. If these layers are not saturated, their stability decreases. At the moment groundwater is extensively being pumped to meet the rising demand of hotels, guesthouses and residents in the suburb of the Siem Reap City. The high level of water abstraction represents a great threat to Angkor's world heritage listed temples.

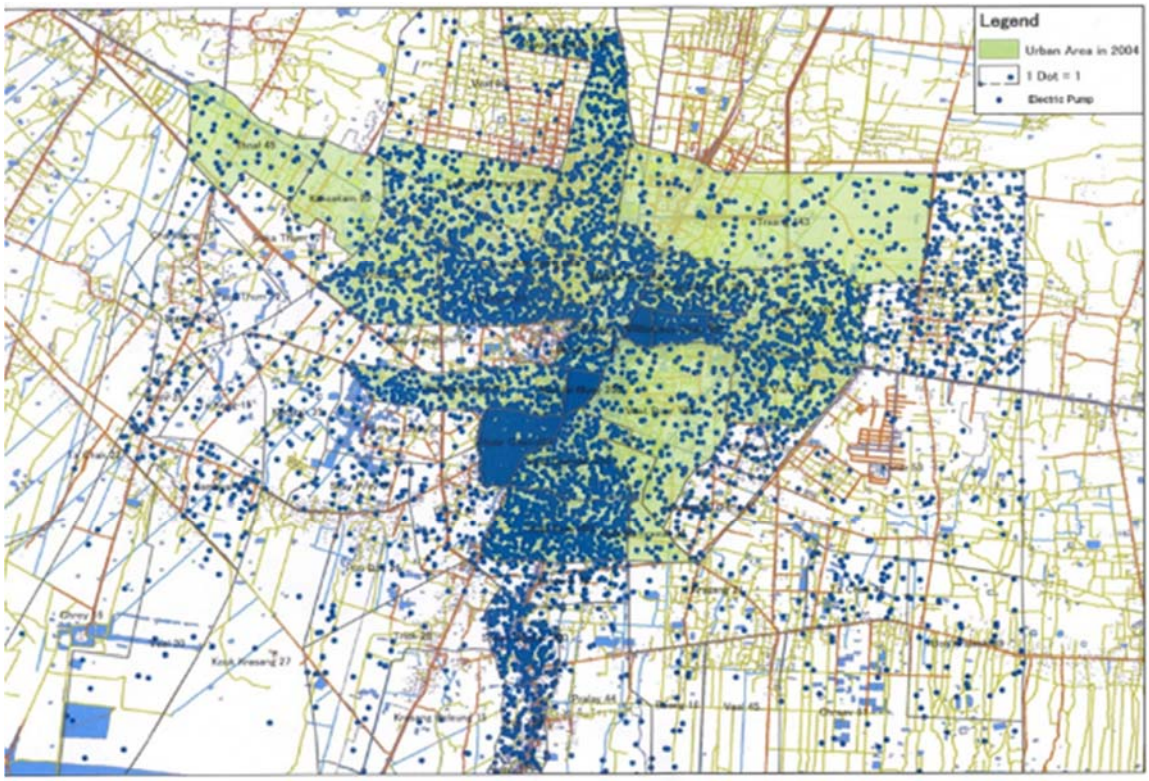


FIGURE 35. ELECTRIC PUMPS IN SIEM REAP TOWN (SOURCE: TOCH SOPHON, DECEMBER 2014. NATIONAL GROUNDWATER RESOURCE ASSESSMENT, SUPPORTING POLICY AND INSTITUTIONAL REFORMS AND CAPACITY DEVELOPMENT IN THE CAMBODIAN WATER SECTOR, CDTA 7610-CAM)

Surface stability and/or mild subsidence was observed (less than −4 mm/year) surrounding the central archaeological zone, including the Preah Khan Temple, west of Angkor Wat, and other monuments around Srah Srang, which can be attributed to not only the restoration of the ancient hydraulic system but also maintaining or raising the water level of reservoirs. The locations of public groundwater pumping wells and observation

boreholes are indicated by the black circles and pink squares (indicated by H1 to H15), respectively. Urbanization surrounding the densely populated areas was rapid, leading to a mild to moderate (−5 to −12 mm/year) surface subsidence in the Siem Reap City region (F. Chen et al., 2017).

Since 2005, APSARA has launched several hydrological projects for the Angkor site; one project involves maintaining or raising the water level of reservoirs, such as those in the Srah Srang, Angkor Thom, and Angkor Wat moats, all of which have been restored to their maximum water-holding capacity. North Baray, which had long been dry, was rehabilitated by collecting 700 000 m^3 of water in 2008, 2 980 000 m^3 in 2009, and 3 678 000 m3 in 2010, reaching its maximum capacity of 5 000 000 m^3 in 2011 (F. Chen et al., 2017). These measures have most likely contributed to surface stability observed around the Preah Khan Temple, west of Angkor Wat, and other monuments around Srah Srang (Figure 36). The groundwater table beneath the airport region can be replenished by the water supply from West Baray as well as from moats of Angkor Thom and Angkor Wat. Observation data from 15 boreholes (marked by pink squares in Figure 36) surrounding the central monument zone, indicated significant seasonal variations (ranging from a depth of 4 to 0.5 m relative to the ground surface) as well as a steady annual trend of groundwater tables from the shallow aquifer during the 2009–2014 observation period.

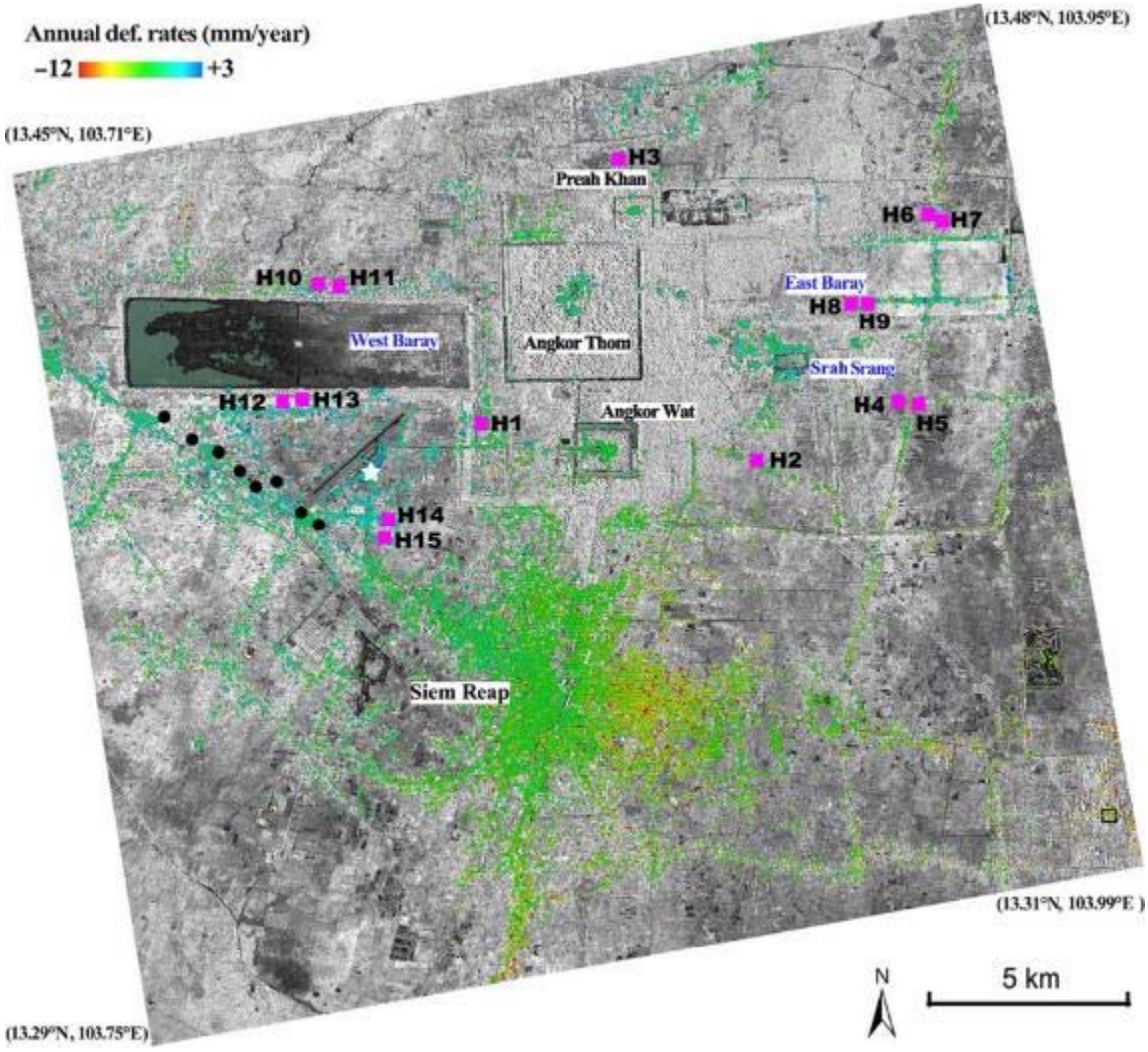


FIGURE 36. REGIONAL-SCALE TOMO-PSINSAR–DERIVED ANNUAL DEFORMATION RATES AROUND THE ANGKOR SITE (REFERENCE POINT IS LOCATED AT THE TERMINAL BUILDING OF THE SIEM REAP INTERNATIONAL AIRPORT, SHOWN BY THE WHITE STAR) FOR THE 2011–2013 OBSERVATION PERIOD (OVERLAPPED ON THE AVERAGED AMPLITUDE OF SAR IMAGERY). (SOURCE: F. CHEN ET AL., 2017)

In Viet Nam's Mekong Delta, several studies have highlighted the urgency of land subsidence due to groundwater over-extraction (Erban et al., 2013, 2014; Fujihara et al., 2016; Karlsrud and Vangelsten, 2017; Minderhoud et al., 2015, 2017, Ministry of Natural Resources and Environment). According to Erban et al. (2014), hydraulic heads have declined significantly throughout most of the Mekong Delta in recent years. Monitoring wells indicate a drop of over 15 m at Ca Mau since the mid-90s, leading to a cone of depression now nearly 20 m below sea level datum. The current rate of hydraulic head decline among Delta wells averages 26 cm yr−1 (range: 9–78 cm yr−1), which has caused widespread regional drawdown in a ~100 km wide trending NE from Ca Mau towards Ho Chi Minh City. Subsidence rates from compaction-based calculations follow a similar pattern (Erban, 2014), modified by the highly variable thicknesses of compressible subsurface layers. Compaction-based subsidence rates average 1.6 cm per year (range: 0.28–3.1 cm/yr). InSAR-based subsidence rates are consistent with compaction-based rates calculated at monitoring wells and range at 1–4 cm/yr (Figure 37).

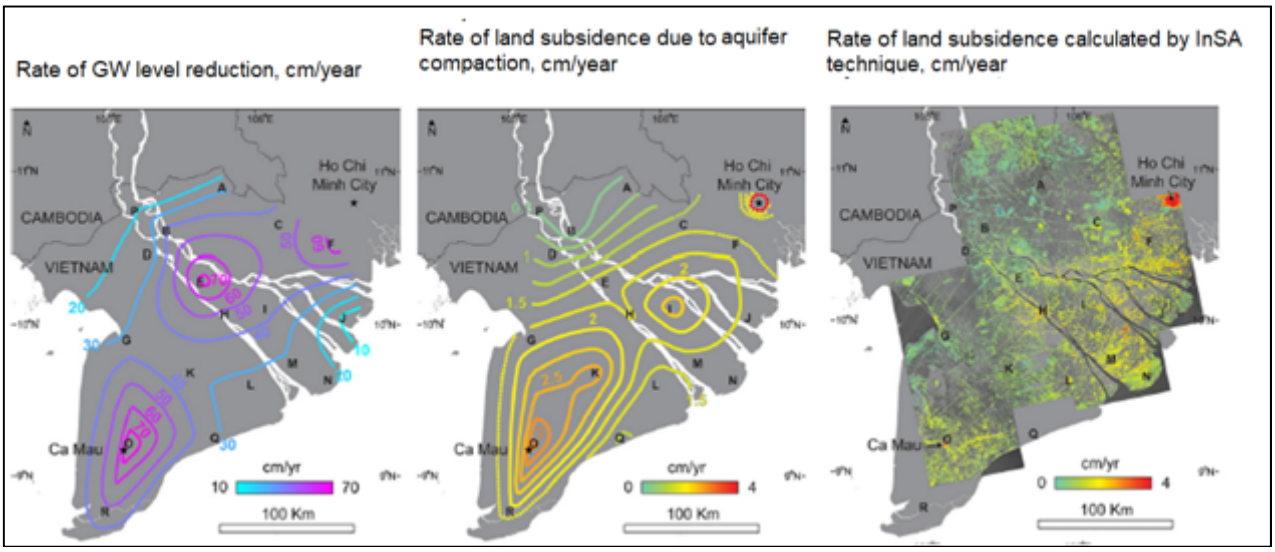


FIGURE 37. HYDRAULIC HEAD DECLINE AND SUBSIDENCE RATES FROM COMPACTION-BASED CALCULATIONS IN MEKONG DELTA VIET NAM (SOURCE: ERBAN, L.E., GORELICK, S.M., ZEBKER, H.A. (2014) GROUNDWATER EXTRACTION, LAND SUBSIDENCE, AND SEA-LEVEL RISE IN THE MEKONG DELTA, VIETNAM. ENVIRON. RES. LETT. 9 (8): 1–6.)

Karlsrud and Vangalsten (2017) estimated the subsidence rate in Ca Mau at 2-4 cm yr-1. In the latest research, Minderhoud et al. (2017) find out the two dominant mechanisms are responsible for causing subsidence and subsequent elevation loss at the scale of the entire Mekong delta: 1) compaction of shallow Holocene sediments by natural sediment loading, enhanced by human loading and drainage, and predominantly causing high subsidence rates near the coast and 2) extraction-induced subsidence following groundwater overexploitation from the deeper subsurface. Lowest mean subsidence rates were found for less-human impacted land-use classes, like marshland and wetland forest (~6-7 mm yr-1), and highest rates for areas with mixed-crop agriculture and cities (~18-20 mm yr-1).

As groundwater levels drop, subsidence is induced through aquifer system compaction. During the past 25 years (1991-2015), the delta sank on average ~170 mm as a consequence of groundwater withdrawal. Current average subsidence rate due to groundwater extraction in the best estimate model amounts to ~9 mm yr-1, with areas subsiding over 25 mm yr-1 (Figure 38).

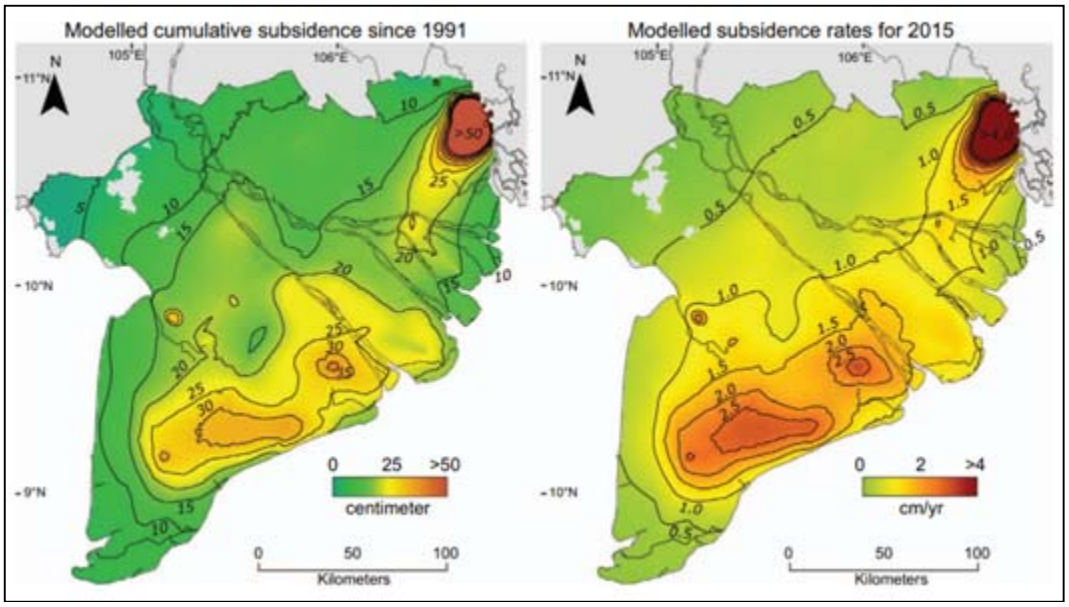


FIGURE 38. (A) MODELLED CUMULATIVE SUBSIDENCE DUE TO GROUNDWATER EXTRACTION-INDUCED DURING 25 YEARS OF GROUNDWATER EXPLOITATION FROM 1991 TO 2015. (B) MODELLED GROUNDWATER EXTRACTION-INDUCED ANNUAL SUBSIDENCE RATES FOR 2015 (SOURCE: MINDERHOUD, P. S. J., G ERKENS, V H PHAM, V T BUI, LERBAN, H KOOI, AND E STOUTHAMER. 2017. IMPACTS OF 25 YEARS OF GROUNDWATER EXTRACTION ON SUBSIDENCE IN THE MEKONG DELTA, VIETNAM. ENVIRON. RES. LETT, 12).

Ground elevation values at 339 landmarks in Ho Chi Minh City and Mekong Delta measured by the Ministry of Natural Resources and Environment in the year of 2014, 2015 and 2017, and the value of ground elevation measured in 2005 showed the subsidence of 306 landmarks. The subsidence rate changes from 0.01 to 6.8cm/year, and an average of 1.07cm/year.

Area with subsidence rates greater than 10cm covers an area of about 3 390km^2, including Ho Chi Minh City, Vinh Long, Can Thơ, Hau Giang, Soc Trang, Dong Thap, An Giang, Bac Lieu, and Ca Mau.
Minderhoud also tested widely used elevation data (Shuttle Radar Topography Mission Digital Elevation Model, SRTM DEM) and found that the average elevation of the delta plain (excluding areas with bedrock outcrops) is only 0.82m instead of the assumed 2.6m (according to the SRTM DEM). Hence, the Mekong delta plain might well be the lowest elevated of all mega deltas in the world and even more vulnerable to sea-level rise than previously understood. Even a moderate sea-level rise (~40 cm by 2100 (Church et al., 2013)) may already result in a quarter of the delta falling below sea level by the end of the century.

In Ho Chi Minh City, a study using Interferometric Synthetic Aperture Radar (InSAR) to monitor land surface subsidence was carried out in 2008. The results of the study show that most areas of Ho Chi Minh City have a land subsidence rate of less than 5mm/year, except an area of 115km^2, which subsides at a rate of 5 to 15 mm/year (Le Van Trung and et al., 2008).

Annex M4: Water quality assessments

Limited data are available to assess the quality of groundwater across all the aquifers in Cambodia although monitoring of the most significant aquifers is carried out (Ministry of Rural Development, MRD, for rural water supply and Ministry of Industry and Handicrafts (MIH), for urban water). The largest volume of accessible data by far is for the alluvial aquifers of the Mekong river/delta system, which has been a response to the discovery of high concentrations of arsenic (Feldman and Rosenboom, 2001). Arsenic constitutes the most significant water-quality problem in the aquifers of Cambodia, although additional and related problems occur with high (often very high) concentrations of iron, manganese and ammonium. Problems also occur due to agricultural, industrial and urban wastewater pollution (Clausen, 2009), including bacterial contamination (ADB, 2013; Thomas et al., 2013). Access to adequate sanitation was in 2002 just available to 50 percent of households in urban areas and <10 percent in rural areas (Irvine et al., 2006). Aquifers in the south-east are also vulnerable to saline intrusion in response to over-extraction.

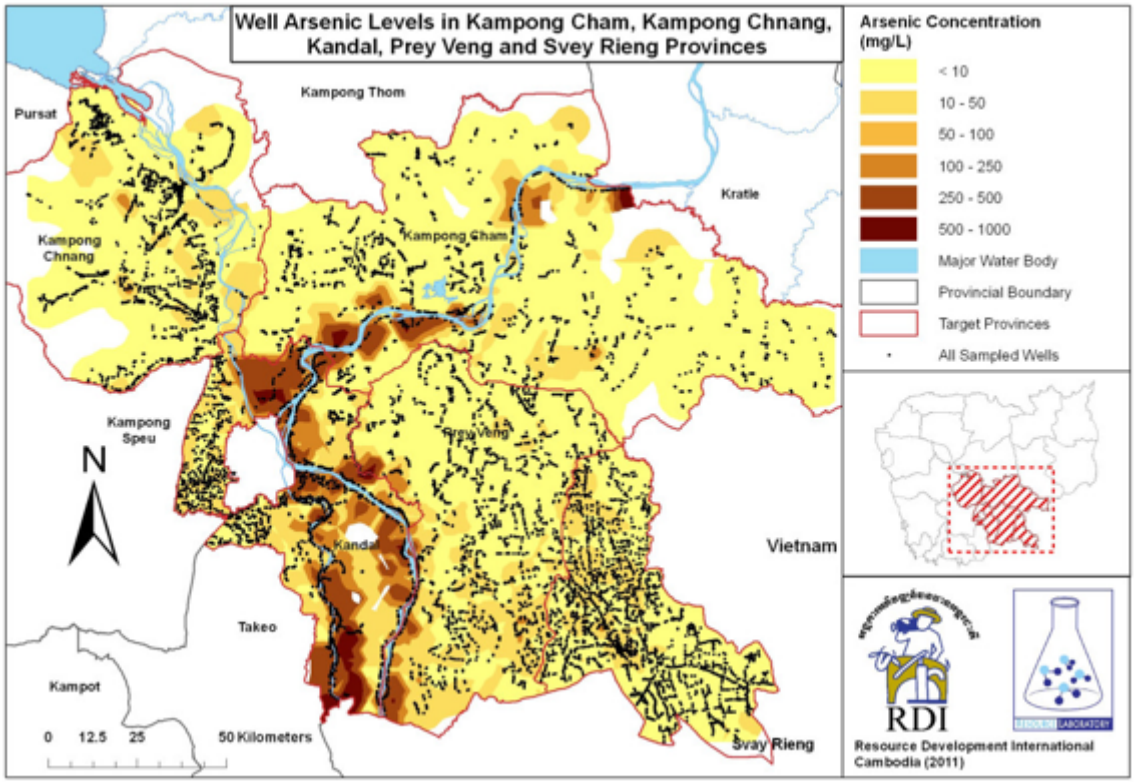


FIGURE 39. WELL ARSENIC LEVELS IN KAMPONG CHAM, KAMPONG CHNANG, KANDAL, PREY VENG AND SVAY RIENG (SOURCE: RDI, 2010); WHO LIMIT IS 10 MG/L.

- Arsenic: RDI (2012) reports arsenic concentrations of up to 3 000 ppb for Cambodia while WHO recommends a limit of 10 ppb and Cambodian drinking water quality standards define a maximum of 50 ppb. Nail and hair samples obtained from residents using groundwater that exceeded the legal limit of 50 µg/L arsenic in Cambodian drinking water contained substantially more arsenic than those of individuals using groundwater containing <50 µg/L arsenic (Gault et al., 2008). Most of the highest arsenic concentrations exist within a distance of 10 km from the Mekong River, its tributaries and ancient buried riverbeds (see Figure 10). Ratha et al. (2017) states that between 2005 and 2009 30 839 of the 47 950 national wells across 7 provinces had been tested for arsenic and that 35-38 percent were contaminated with arsenic above the Cambodian Standard of 50ppb. Nearly 50 percent of the tube-wells in the lower floodplains of the Mekong and the Bassac Rivers in Kandal were contaminated and nearly 3 percent of wells along the Stung Saen River in Kampong Thom.

WHO conducted a survey of drinking water quality involving 13 of Cambodia's most densely populated provinces, which revealed arsenic concentrations of 100–500 µg/L in hand-pumped and tube-wells (Feldman and Rosenboom, 2001). As a consequence, about 5000 tube-wells were tested by 25 NGOs in 2002 and 2003 using arsenic field-testing kits provided by UNICEF (Halperin, 2003). According to these studies, 20 percent of the wells located within risk zones had arsenic levels above 50 µg/L and 50 percent were above 10 µg/L.

- Manganese is a neurotoxin for which Cambodia and WHO defined Drinking Water Standards (DWS) of 0.4 mg/l. RDI (2012) studies found very high Manganese concentrations throughout Kean Svay District in Kandal Province and in tube wells in Kandal, Prey Veng, and Kampong Cham Provinces.
- Fluoride: The Cambodian government introduced a fluoride limit of 1 mg/l drinking water while the WHO recommends a limit of 1.5 mg/l. Study have found fluoride levels that exceed the water standards (of up to 3 mg/l) in 18 percent of tested wells across five central and south-eastern provinces (Kampong Cham, Kampong Chhnang, Kampong Speu, Takeo and Svay Rieng Provinces).
- Nitrate: WHO recommends a DWS of 11.3 mg/l (as N). Nitrate levels are affected by nitrogenous fertilizers or domestic/urban waste. A high proportion of the groundwaters in the alluvial aquifers of the Mekong-Bassac-Tonle Sap system have low concentrations of nitrate. Elsewhere in sandstone and bedrock aquifers, concentrations can be higher, especially at shallow depths. Pockets of aquifer contamination have been found in northern Prey Veng Province, Sithor Kandal District, where many shallow tube wells exist, population density is high, cows and pigs are commonly raised under houses, and waste management practices are poor.
- Iron concentrations are generally very high in the groundwaters of Cambodia. The drinking water quality standard for iron is 0.3 mg/l based. Iron concentrations in the Mekong floodplain have been observed to reach 32 mg/l. High concentrations of iron and manganese are also found in boreholes within the alluvial/lacustrine aquifer around the Tonle Sap Lake (ADB, 2013).

Since 2005, RDI has been conducting groundwater surveying activities from province-to-province, collecting samples and analyzing them in our laboratory. Over 10 000 wells have been tested in five priority provinces. RDI developed a drinking water quality index (DWQI) to present groundwater risk at the commune level. The highest water quality is assigned 100 while a value of 1 indicates very poor groundwater quality. Figure 40 presents the DWQI for each commune in Kandal, Prey Veng, Kampong Cham and Kampong Chnang.

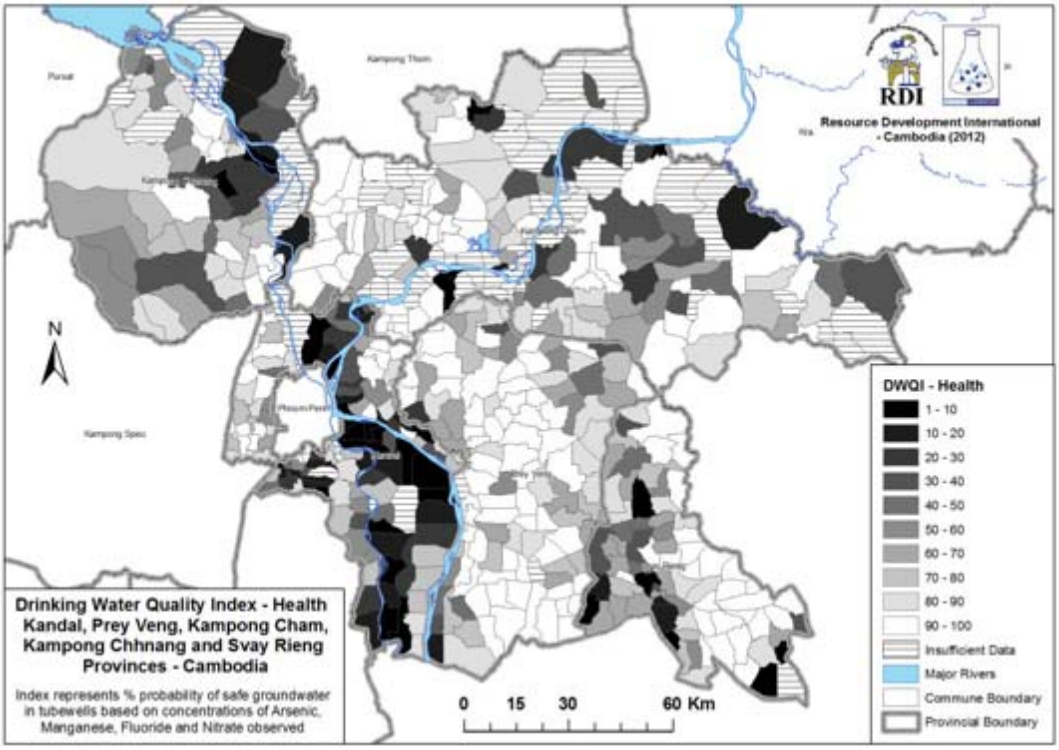


FIGURE 40. DRINKING WATER QUALITY INDEX (DWQI) HEALTH IN KAMPONG CHAM, KAMPONG CHNANG, KANDAL, PREY VENG AND SVAY RIENG (SOURCE: RDI, 2010)

One of the major water quality issues in Viet Nam's Mekong Delta region is arsenic although less problematic than on the Cambodian side. Michael Berg and et al. (2007) report arsenic concentrations of up to 845 µg/L in the Mekong Delta. Yasuhiro Shinkai and et al., found concentrations of up to 321 µg/l. Recently, high levels of Arsenic in groundwater were recorded in An Giang, Dong Thap, Can Thơ, Tien Giang and Soc Trang provinces (Erban et al. 2013). Arsenic dissolved concentrations are highest (maximum 1 470 µg/L) in the shallow subsurface (<100m) in close proximity (<5km) to the main river and its distributaries, and drop off sharply with distance. Wells with concentrations up to 1 000 µg/L are often less than 100 m away from others with no detectable arsenic. A survey of Arsenic occurrence in An Phu district, An Giang province, at the Cambodian border (Vo Le Phu and et al, 2015) found arsenic concentrations of 208 to 1 523 µg/L, which varied by seasons and locations. Arsenic concentrations in January exceeded those in May and August.

The most prominent arsenic hot-spot region is located approximately 50 km southwest of Ho Chi Minh City (HCMC) and is over 1 000 km^2 in extent. This area contains 1 059 wells with arsenic exceeding 10 µg/L (Figure 11). These wells are divided into two sets: those in shallow Holocene–Pleistocene aquifers and those tapping the deep Pliocene–Miocene aquifers. The deep set (170–500 m) contains the majority (84 percent) of arsenic-contaminated wells. Arsenic contamination declines with depth and age of the aquifers. Wells with concentrations exceeding 1 000 µg/L are only found in the shallow Holocene and Pleistocene aquifers.

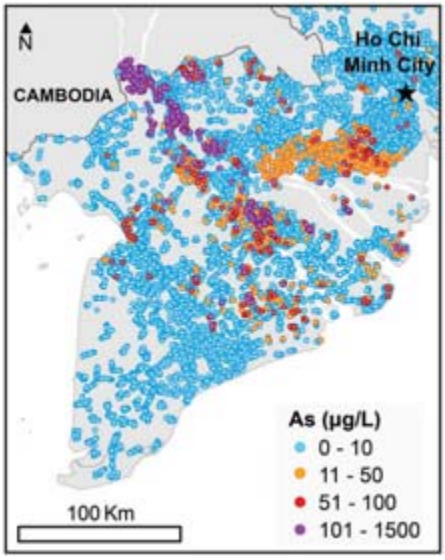


FIGURE 41. GROUNDWATER ARSENIC CONCENTRATIONS IN THE MEKONG DELTA, VIET NAM (SOURCE: ERBAN, L. E., S. M. GORELICKA, H. A. ZEBKERB, AND S. FENDORFA. (2013). RELEASE OF ARSENIC TO DEEP GROUNDWATER IN THE MEKONG DELTA, VIETNAM, LINKED TO PUMPING-INDUCED LAND SUBSIDENCE. PNAS 10 AUGUST 110 (34): 13751-13756)

Annex M5: Groundwater dependent ecosystems

Table 27 lists wetland sites for the Cambodian side of the CMDA, which includes a few sites of international significance, including one RAMSAR site.

TABLE 27: WETLANDS ON THE CAMBODIAN SIDE OF THE CMDA

No.	Wetland Site	Location	Coordinates	Area (ha)	Marsh	River/Creek	Lake	Flooded	Rice Field	Lotus Field	Stream
1	Stung Treng Mekong River Flooded Forest	Stung Treng Provincial Town	13°11'50"-13°56'00" N 105°52'00"-106°03'50" E	48 000		x		x	x		
2	Tonle Sekong River System	Stung Treng	13°31'00"-14°28'00" N 105°57'30"-106°26'00" E	34 750		x		x			
3	Tonle Sesan River System	35 km from Ratanakiri Provincial Town	13°32'00"-14°06'00" N 105°58'00"-107°27'50" E	146 250		x					
4	Tonle Sre Pork River System	30 km S from Ratanakiri Provincial Town	13°01'15"-13°33'20" N 106°17'30"-107°30'00" E	157 500	x	x		x			x
5	Kratie River System	Kratie	12°08'35"-13°12'00" N 105°28'50"-106°09'00" E	142 250		x		x	x		
6	Peam Chileang Mekong River System	10 km N-E from Kampong Cham Provincial Town	12°00'00"-12°18'30" N 105°28'50"-105°52'00" E	63 750	x	x	x				
7	Siem Bok Mekong River System	Kampong Cham	11°50'10"-12°00'00" N 105°02'00"-105°29'00" E								
8	Boeung Veal Sam Nap	10 km in the North-East of Phnom Penh	11°33'17"-11°38'25" N 105°00'15"-15°06'00" E	10 850	x		x	x			
9	Boeung Prang	11 km in the North-East of Phnom Penh	11°32'00"-11°45'25" N 105°07'00"-105°15'00" E	12 600	x		x	x	x		
10	Boeung Pring	Prey Veng Province about 30 km from Neak Loeung	11°22'15"-11°29'27" N 105°23'00"-105°26'15" E	16 000	x		x	x			
11	Boeung Khsach Sor	Prey Veng	11°23'00"-11°22'15" N 105°19'17"-105°23'28" E		x		x	x			
12	Upper Stung Sen Creek System	55 km in the South-West of Preah Vihea Province	13°48'00"-14°13'00" N 104°32'20"-104°58'30" E	80 000	x	x			x		
13	**Prek Toal**	**Battambang**	12°59'00"-13°20'30" N 103°26'30"-103°43'25" E		**x**	**x**	**x**	**x**			
14	Moat Peam	15 km in the South of Siem Reap Provincial Town	13°03'00"-13°19'00" N 103°43'00"-104°12'00" E	45 000	x		x	x	x		
15	Stung Daun Try	60 km N-E from Pursat Provincial Town	12°44'00"-13°00'00" N 103°37'00"-103°53'00" E	103 000	x	x	x	x	x		
16	Pursat Great Lake System	25 km in the North of Pursat Provincial Town	12°28'00"-12°51'00" N 103°52'30"-104°23'35" E	55 000	x		x	x	x		
17	**Moat Khla**	**Siem Reap**	12°44'15"-13°04'00" N 103°08'00"-104°15'00" E	45 000	x		x	x	x		
18	**Boeung Tonle Chhmar (RAMSAR)**	**Kampong Thom**	12°44'25"-12°55'20" N 104°15'10"-104°22'00" E	28 000	x	x	x	x	x		
19	Lower Stung Sen	15 km in the West of Kampong Thom Town	12°31'50"-12°49'00" N 104°27'40"-104°47'00" E	61 200	x	x	x	x	x		
20	Boeung Veal Pork	10 km from Kampong Chhnang Provincial Town	12°17'00"-12°32'00" N 104°02'00"-104°45'00" E	56 500	x	x	x	x	x		
21	Boeung Thom	About 5 km from Kampong Chhnang town	12°09'00"-12°31'10" N 104°42'00"-104°59'00" E	72 500	x	x	x	x	x		
22	Boeung Sam Rong	Kandal	11°39'10"-11°42'00" N 104°46'20"-104°48'10" E		x		x	x	x	x	
23	Boeung Ta Mouk	Kandal	11°37'00"-11°40'00" N 104°46'25"-104°48'20" E		x		x	x	x	x	

24	Prasat Tuyav Lake	SE of Phnom Penh about 57 km (Kandal Province)	11°07'00"-11°12'20" N 105°05'27"-105°10'00" E	72 000	x		x	x	x	x	

Source: Cambodian Wetland Overview and Identification Report (1997)

Wetlands of the Mekong Delta are among the richest ecosystems of the basin (tidal floodplains, coastal marshes, peatland marsh, estuaries, etc.) and are important breeding sites for many aquatic species migrating to and from upper reaches of the Mekong River. Mekong Delta wetlands covers 4 939 684 ha, which includes inland wetlands and coastal wetlands with a depth of less than six meters at low tide (Figure 42).

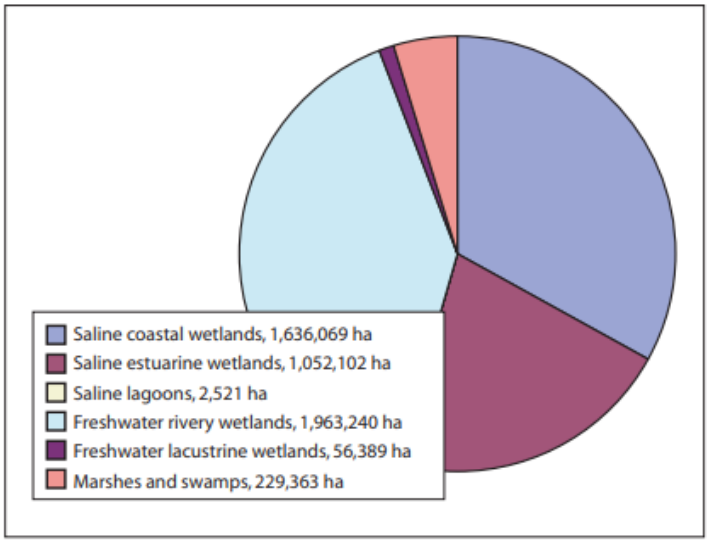


FIGURE 42. AREAS FOR WETLAND TYPES IN THE MEKONG DELTA (SOURCE: SOUTHERN SUB-FIPI, 2003)

Saline coastal wetlands are distributed along the coastline of the East Sea, southwest of the Ca Mau Peninsula and the Gulf of Thailand. Of a total of 1 636 069 ha, 879 644 ha are permanently flooded wetlands distributed in the sea region at depths less than six meters at low tide, and 756 425 ha are seasonally flooded. The most common wetland types in this area include permanently flooded and non-vegetated saltwater wetlands, seasonal saltwater wetlands for agricultural cultivation, and seasonal saltwater wetlands for aquaculture. Mangrove forests along the coastline play a very important role in the coastal wetland ecosystem. In the past, mangrove cover was extensive along the coast, but mangroves have since been degraded and reduced substantially in terms of both quantity and quality.

Estuarine wetlands are distributed mainly in the mouth of the Mekong River in the provinces Long An, Tien Giang, Ben Tre, Tra Vinh and Soc Trang. They are either seasonal saltwater wetlands for agricultural cultivation or seasonal saltwater wetlands for aquaculture. Saltwater lagoons are distributed in Dong Ho Lagoon (Ha Tien) and Thi Tuong Lagoon (Ca Mau) within the coastal area of the Gulf of Thailand.

Riverine wetlands cover a huge floodplain in the center of the Mekong Delta. Permanent riverine wetlands are major tributaries of the Tien and Hau Rivers, and of other rivers and channels, covering 128 139 ha. Seasonal riverine wetlands have an area of 1 771 381 ha and are mainly rice fields, fruit gardens and other agricultural cultivation areas.

Lacustrine wetlands are distributed in lakes of Melaleuca forest in U Minh Ha (Ca Mau Province), lakes of Melaleuca forest in U Minh Thuong (Kien Giang Province) and in Tram Chim National Park (Dong Thap Province). In the past, Melaleuca forests covered almost all acid sulphate regions of the Mekong Delta. Nowadays, only 182 170 ha of Melaleuca forest remain, and are distributed mainly in the U Minh peatland area, in the acid sulphate soil area of the Plain of Reeds and in the Ha Tien grassland region. These are habitats for many freshwater aquatic species and also provide woods, fuels, fishes and honey. An outstanding feature is that a peaty soil layer in the U Minh Melaleuca forest plays a very important role in the ecosystem. Under saturated conditions, the peat will prevent the process of acidification in potentially acidic sulphate soil. Under dry

conditions however, such as when the wetlands are drained, the peat is rapidly oxidized, leading to acidification of the soil.

Swamps and marshes in the Mekong Delta are mainly intermittent marshes used for agricultural cultivation. They are distributed in the Plain of Reeds and Long Xuyen Quadrangle.

Major wetland ecosystems in the Mekong Delta are very important to the region, and include mangroves, Melaleuca forests, and estuaries. Some typical wetlands in the region are wetland national parks and nature reserves that have been established by the Prime Minister (Table 28 and Figure 43). Four sites within the Mekong Delta are Ramsar-listed wetlands, namely the Tram Chi National Park (listed in 2012), Ca Mau National Park (listed in 2013), Lang Sen Wetland Reserve (listed in 2015), and the U Minh Thuong National Park (listed in 2016).

TABLE 28. EXISTING PROTECTED WETLANDS AND IMPORTANT BIRD AREAS IN THE MEKONG DELTA (SOURCES: BUCKTON ET AL. 1999; SENG KIM ET AL. 2003; GOVERNMENT OF VIET NAM 2014)

Name	Major wetland types	Location	Area (hectares)	Protection status
Boeung Prek Lapouv Protected Landscape	Freshwater marshes	Takeo Province, Cambodia	>8 300	Wildlife sanctuary
Anlung Pring Protected Landscape	Brackish and freshwater marshes	Kampot Province, Cambodia	217	Wildlife sanctuary
Boeung Veal Samnap	Freshwater marshes and shallow lake	Kandal Province, Cambodia	11 286	Important Bird Area
Bassac Marsh	Freshwater marshes	Kandal Province, Cambodia	52 316	Important Bird Area
Lang Sen	Melaleuca swamp forest and freshwater marshes	Long An Province, Viet Nam	5 030	Provincial protected area (Ramsar site)
Dong Thap Muoi	Melaleuca swamp forest and freshwater marshes	Long An Province, Viet Nam	633	Provincial protected area
Tram Chim	Melaleuca swamp forest and freshwater marshes	Dong Thap Province, Viet Nam	7 300	National park (Ramsar site)
Xeo Quyt	Melaleuca swamp forest and freshwater marshes	Dong Thap Province, Viet Nam	50	Provincial nature conservation and historical site
Tra Su	Melaleuca swamp forest and freshwater marshes	An Giang Province, Viet Nam	850	Provincial protected area
Lung Ngoc Hoang	Melaleuca swamp forest and freshwater marshes	Hau Giang Province, Viet Nam	790	Provincial protected area
U Minh Thuong	Peat swamp forest	Kien Giang Province, Viet Nam	8 038	National park
U Minh Ha	Peat swamp forest	Ca Mau Province, Viet Nam	7 926	National park
Thanh Phu	Mangrove forests	Ben Tre Province, Viet Nam	2 584	Provincial protected area

Name	Major wetland types	Location	Area (hectares)	Protection status
Bac Lieu bird colony	Mangrove forest	Bac Lieu Province, Viet Nam	385	Provincial protected area
Dam Doi bird colony	Mangrove forest	Ca Mau Province, Viet Nam	130	Provincial protected area
Mui Ca Mau	Mangrove forest	Ca Mau Province, Viet Nam	41 089	National park

FIGURE 43. LOCATION OF PROTECTED WETLANDS AND IMPORTANT BIRD AREAS IN THE MEKONG DELTA (SOURCES: BUCKTON ET AL. 1999; SENG KIM ET AL. 2003; GOVERNMENT OF VIET NAM 2014)

Wetland loss and degradation: The human exploitation of the Mekong Delta has led to changes in natural hydrological, ecological, and morphological processes. Drainage and canal construction for agriculture and transport first occurred over 1 000 years ago. Canals were constructed primarily for transport. Large-scale canal construction for irrigation and drainage commenced in late nineteenth century by the French and continued until the end of Indochina War in 1975. A more recent phase of canal construction commenced after 1975, under central government schemes for irrigation and land reclamation for rice production, resulting in more than 10 000 km of major canals. These canals have dramatically changed the nature of the delta and profoundly altered the basin's hydrology, as excessive drainage of surface water from the wetlands has reduced the period of flooding from 12 to 4–6 months.

Today, many areas of former swampy terrain and dense wetland forests have been transformed into housing and farms. The Mekong Delta, which was once one of the world's great wetlands, has now become a rice bowl, with only about 1– 1.5 percent of the wetlands remaining in a natural or semi natural states. As a result of these factors, only 0.068 million ha of the original 4.0 million ha of the Mekong Delta currently remains as primary swamp forest ecosystem.

Drivers of change in wetland area: Wetland loss or degradation is the result of the interaction of a wide range of social and economic processes. Frequently cited anthropogenic causes of wetland loss and degradation include wetland drainage and conversion for crop production, aquaculture, conversion for logging, construction of canals, dykes, and dams and urbanization. Population growth and economic growth were the most important underlying driving forces of wetland conversion. The more the demand for land for infrastructural development, the more wetland was drained and converted to other land use types.

While there have not been any studies that detail the impacts of groundwater abstraction on wetlands in the Mekong Delta it is well understood that wetlands provide important recharge areas for aquifers. Concurrently, if groundwater levels drop, wetlands can dry out, either seasonally or permanently. Consequently, ecosystems services derived from wetlands depend heavily on the supporting groundwater levels and are highly vulnerable to groundwater over-extraction.

Annex M6: Socio economic assessment for Cambodia

The variety of interlinked bio-physical changes shift conditions for communities and affect a wide range of socio-economic indicators, including poverty and livelihoods.
Cambodia has a population of 16 048 808 persons (8 170 850 female) with an annual growth rate of 1.2 percent (NIS 2019) and an annual household income per capital of 1 392 USD in 2017 (NIS 2018). However, the majority of the population with higher income live in the capital while the 68.4 percent of Cambodians live in rural areas and earn considerably less income (NIS 2018).
Within the 22 provinces and 1 capital city of Cambodia that depend on the CDMA system live almost 3.5 million households including an average of 18 percent of female headed families (FHH) or equal up to 16 million people of which 51 percent are women, are living across the six different geographical regions with an average household size of 4.52. The majority of the population lives in the lower Mekong which accounts for around 5 million people followed by around 4 million people in the Southern Tonle Sap and 3 million people in the Northern Tonle Sap lake. The least populated region is the upper Mekong with less than 1 million people although it has the highest density of Indigenous Peoples (IP), which account for 10.25 percent of households. In the Northern Tonle Sap region Indigenous Peoples make up only 0.45 percent of the population, in the Southern Tonle Sap only 0.14 percent, in Lower Mekong only 0.03 percent, and in the Coastal Region only 0.01 percent. The main ethnicities are Kouy, Punong, Steang, Souy and Tompoun and follows by other Charay, Kanchork, Por, Merl, Krerl, Thmorn, Khernh, Chorng, Kreung, Sa Och, Kavet, Lun, and Rodai. There is no IP population reported for Phnom Penh Capital (Provincial Department of Planning, 2019: Socioeconomic Reports).

TABLE 29: DEMOGRAPHICS BY REGIONS

Regions	Total HH	FHH	HH Size	Total Population	Female	IP HH	IP Population
Phnom Penh	294 705	15%	5.00	1 474 489	52%	0.00%	0.00%
Southern Tonle Sap	921 467	14%	4.37	4 095 642	51%	0.11%	0.10%
Northern Tonle Sap	732 633	22%	4.42	3 256 580	51%	0.45%	0.45%
Upper Mekong	184 569	25%	4.35	808 267	50%	10.25%	10.11%
Lower Mekong	1 125 424	16%	4.45	5 030 076	51%	0.04%	0.03%
Coastal	239 706	16%	4.54	1 090 773	51%	0.01%	0.01%
Total or average	**3 498 504**	**18%**	**4.52**	**15 755 827**	**51%**	**2%**	**2%**

Cambodia ranks 146 of 189 countries on the UNDP Human Development Index (score: 0.581), which is below the average score of 0.634. Cambodia falls into the medium human development group (UNDP 2019). Following the UNDP Multidimensional Poverty Index (MPI) in 2019, 37.2 percent of the population or about 6 million people are multi-dimensionally poor while an additional 21.1 percent are classified vulnerable (UNDP 2019). It is estimated that 12.9 percent of the population live under the poverty line (ADB 2019).

According to ID Poor (Ministry of Planning, MOP), an average of 14 percent of households (or 541 945 households) across all six regions of the groundwater aquifers of Cambodia are considered poor. The upper Mekong is reportedly the poorest which a poverty rate of 19 percent, which equals 37 514 poor households. The Southern Tonle Sap region follows with 17 percent or 171 840 households considered poor. In the Coastal region 15 percent or 33 803 households are considered poor while the poverty rate in the Lower Mekong and the Northern Tonle Sap regions are similar to the national poverty average with 14 percent and 13 percent

respectively (Table 30). Phnom Penh Capital is the richest region with a poverty level of 8 percent or 16 283 poor households.

TABLE 30: POVERTY RATE OR PERCENTAGE OF POOR HOUSEHOLDS

Region	Number of Poor Household	Percentage
Phnom Penh	16283	8%
Southern Tonle Sap	171840	17%
Northern Tonle Sap	109744	13%
Upper Mekong	37514	19%
Lower Mekong	172761	14%
Coastal	33803	15%
Total or average	**541945**	**14%**

After experiencing accelerated growth of 7.5 percent in 2018, Cambodian economy achieved 7 percent of growth in 2019. The robust economic growth results in continued poverty reduction. However, in February 2019, the EU started to reduce Cambodia's preferential access under the Everything But Arms (EBA) scheme, which could slow down exports and growth reduce employment (World Bank 2019).

The COVID-19 pandemic continues to cause the loss of jobs in several productive sectors and has affected the poor and vulnerable particularly harsh. It has been estimated that 390 000 jobs have been lost in 2020 alone and that 1.3 million people will be pushed back into poverty (World Bank 2019). The World Bank Economic Outlook (2020) estimates that at least 1.76 million direct jobs are at risk across different sectors. GDP of the country for 2020 is estimated to be negative and shrink by 2 percent (World Bank 2019).

People living on the Cambodian side of the CMDA are mainly involved in three primary livelihoods, agriculture, handicraft and different services. The combined labor force across these three primary livelihoods involves 7 151 560 people, including 45 percent women. Agricultural production represents over 64 percent while different services accounts for 35 percent. Only a minority is involved in handicraft.
Among the 7 million persons who are involved in different primary livelihood activities from the six regions, almost 5 million persons (including almost 2 million women) depend on agriculture related production such as rice, long-term and short-term crops, horticulture, fishing, livestock production and Non-Timber Forest Products collection. Agricultural production constitutes the main livelihood for 20-40 percent of households in the Lower Mekong, the Southern Tonle Sap and the Northern Tonle Sap region while in the Upper Mekong and the Coastal regions only 7 percent of households depend on agricultural livelihoods. In Phnom Penh only very few people engage in agriculture (Table 31 and Figure 44).

TABLE 31: AGRICULTURE RELATED PRODUCTION LIVELIHOODS COMPARISON BY REGIONS

Region	Agriculture (person)								
	Total	F	Rice	Long term crop	Short term crop	Horticulture	Fishing	Livestock	NTFPs
Phnom Penh	1%	1%	1%	2%	1%	2%	3%	1%	0%
Southern Tonle Sap	27%	24%	26%	19%	31%	34%	24%	34%	32%
Northern Tonle Sap	24%	23%	24%	23%	21%	18%	25%	21%	19%
Upper Mekong	7%	7%	5%	16%	12%	7%	4%	7%	20%
Lower Mekong	35%	36%	35%	37%	31%	33%	26%	29%	0%
Coastal	7%	8%	8%	4%	3%	6%	19%	8%	30%
Percentage	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Total	**4556830**	**1987062**	**3539617**	**290513**	**394996**	**114413**	**97572**	**111935**	**7784**

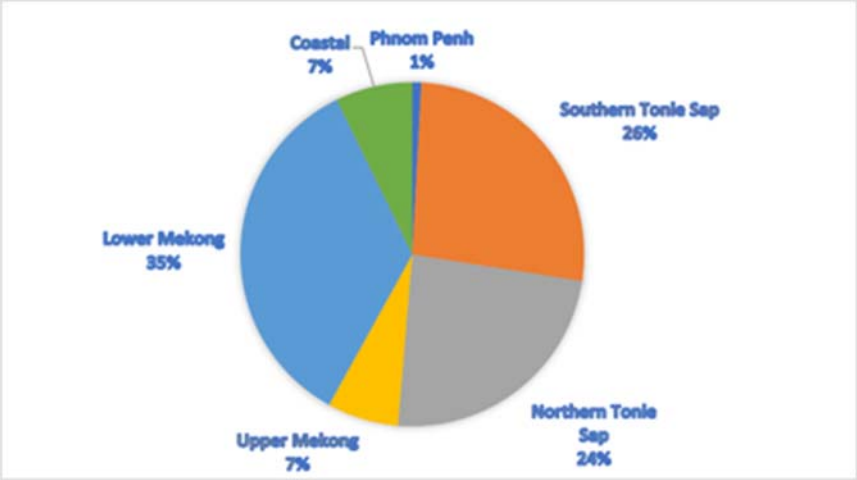


FIGURE 44: AGRICULTURE RELATED LIVELIHOODS FOR THE SIX REGIONS IN % (SOURCE: CREATED BY AUTHORS)

Of the 4 556 830 people that are involved in agriculture related livelihood activities, an average of 74 percent (range: 63 percent to 82 percent) or almost 4 million people engage in rice cultivation while 8.92 percent and 8.04 percent cultivate long term and short-term crops, respectively. The remaining 331 704 people are involving in horticulture (2.95 percent), fishing (3.24 percent), livestock (2.69 percent) and NTFPs collection (0.26 percent). Rice production is seen as the major and dominant agricultural product in all six regions, see Table 32.

TABLE 32: AGRICULTURE RELATED PRODUCTION LIVELIHOODS COMPARISON BY SUBSECTORS

Region	Agriculture (person)								
	Total	F	Rice	Long term crop	Short term crop	Horticulture	Fishing	Livestock	NTFPs
Phnom Penh	9 081	17 756	63%	12%	8%	6%	7%	4%	0%
Southern Tonle Sap	1 212 961	484 212	77%	4%	10%	3%	2%	3%	0%
Northern Tonle Sap	1 087 372	465 271	80%	6%	8%	2%	2%	2%	0%
Upper Mekong	305 496	147 258	63%	15%	16%	3%	1%	3%	1%
Lower Mekong	1 582 324	712 069	79%	7%	8%	2%	2%	2%	0%
Coastal	329 596	160 496	82%	4%	4%	2%	6%	3%	1%
Total or Average	**4 556 830**	**1 987 062**	**3 539 617**	**290 513**	**394 996**	**114 413**	**97 572**	**111 935**	**3 539 617**
Percentage	**100%**	**100%**	**74%**	**8.04%**	**8.92%**	**2.95%**	**3.24%**	**2.69%**	**0.26%**

Rice production is the main source of food and income for agricultural farmers in Cambodia. Almost 4 million ha of land are under rice cultivation, of which each hectare produces an average of 2.36 tons, totally up to 10 million tons per annum. Farming households can generate net annual income of USD 496 per person in average or USD 2 188.36 per household, see Table 33.
The most intensive rice production locates in the Southern Tonle Sap, the Lower Mekong and in the Northern Tonle Sap where rice covers 1 299 306 ha, 1 205 613 ha and 975 073 ha, respectively. The upper Mekong and the Coastal region show lower intensities as the rice production covers around 200 000 ha. In Phnom Penh rice occupies only 10 308 ha, see Table 33.

TABLE 33: RICE PRODUCTION BY REGIONS

Region	Rice production			Income from rice (USD)	AVG per HH	Total income per annual in USD/HH
	Land (ha)	Yield (t/ha)	Production (t)			
Phnom Penh	10 308	2.30	23 404	4	5.00	20
Southern Tonle Sap	1 299 306	2.40	3 105 334	911	4.37	3 960
Northern Tonle Sap	975 073	2.10	2 070 467	616	4.42	2 738
Upper Mekong	203 639	1.90	382 502	390	4.35	1 683
Lower Mekong	1 205 613	2.98	3 627 010	778	4.45	3 480
Coastal	177 749	2.48	467 711	276	4.54	1 250
Total/Average	**3 871 689**	**2.36**	**9 676 428**	**496**	**4.52**	**2 188.36**

(Source: Provincial Department of Planning, 2019).

Rice production relies heavily on water, which could be rainwater or irrigated water. Assuming that farmers have the same technical skills and access to other inputs, it has been estimated that 1 hectare of rice cultivated area requires 12 000 cubic meters of water per crop cycle (Julian Hilton Abrams, 2015). Therefore, the total rice cultivated areas of 3 871 689 ha consumes 46 460 million cubic meters per crop cycle.

Vegetables and short-term crop production include several varieties of vegetables, maize, soy beans, bean, peanut, cassava, sweet potato and sesame. In the six regions, all of these vegetables and short-term crop varieties are grown for either subsistence or small additional income generation besides rice products. In total, vegetables and short-term crops occupy 1 373 547 ha of land with an average yield of 3.17 tons per hectare. Total production is therefore 16.5 million tons per annum. Among the six regions, the largest area under this category locates in the Lower Mekong with 698 204 ha, followed by the Southern Tonle Sap and the Northern Tonle Sap with 370 293 ha and 202 792 ha, respectively. In the Upper Mekong region, less than 100 000 ha are used to grow vegetables, and even less in the Coastal region and in Phnom Penh, see Table 34.

TABLE 34: VEGETABLES AND SHORT-TERM CROPS PRODUCTION BY REGIONS

Region	Short-term production			Income from short term crop (USD)	AVG per HH	Total income per annual in USD/HH
	Land (ha)	Yield (t/ha)	Production (t)			
Phnom Penh	197	2.57	1 392	0	5.00	2
Southern Tonle Sap	370 293	3.36	4 005 386	1 112	4.37	5 070
Northern Tonle Sap	202 792	3.79	2 515 751	421	4.42	1 794
Upper Mekong	98 285	3.47	851 345	291	4.35	1 262
Lower Mekong	698 204	3.68	9 146 274	669	4.45	2 957
Coastal	3 776	2.15	13 467	15	4.54	67
Total/Average	**1 373 547**	**3.17**	**16 533 614**	**418**	**4.52**	**1 858.73**

In terms of income, vegetable farmers in the Lower Mekong region earn with USD 2 957 in average less than farmers in the Southern Tonle Sap with USD 5 070 region despite the larger area. In the Upper Mekong and the Northern Tonle Sap region, the average farming family generated between USD 1 262 and USD 1 794 per annum. The coastal region and Phnom Penh show only marginal income form vegetables and short-term crops livelihood (Table 34).

Irrigation for vegetables and short-term crops such as bean, soy bean and peanut have been trailed by the project “Promoting Climate-Resilient Water Management and Agricultural Practices in Rural Cambodia” in 2015 confirming that each 0.2 hectare of vegetables, requires 1 500 cubic meters for a duration of six month of each year. Therefore, the total cultivated land areas of 1 373 547 ha requires 10 302 million cubic meters of water for irrigation during a six-month period.

Industrial crops include several varieties such as sugarcane, rubber, coconut oil, pepper, cashew, mango, durian, rambutan, mangosteen, dragon fruit, longan and grape. Industrial crops are the strategic agricultural products, which help to accelerate the economic growth of the country through export and processing.

In the six regions, all industrial crops have different product cycles from one year to seven years in order to harvest. Across the six regions 1 745 673 ha are under industrial crops, with an average yield of 21.02 tons per hectare. The total production is almost 44 444 723 tons for 2019 (incl. rubber, mango, coconut oil, durian, cashew, pepper etc.). Among the six regions, the Northern Tonle Sap region ranks with 1 054 861 ha as the largest area for industrial crops, followed by the Lower Mekong, the Southern Tonle Sap and the Upper Mekong regions with 291 318 ha, 178 131 and 164 755 ha, respectively. In the Coastal region, only 56 183 ha are used for industrial crops and almost nothing in Phnom Penh, see Table 35.

TABLE 35: INDUSTRIAL CROPS PRODUCTION BY REGIONS

Region	Industrial Crops			Income from short term crop (USD)	AVG per HH	Total income per annual in USD/HH
	Land (ha)	Yield (t/ha)	Production (t)			
Phnom Penh	425	0.46	1 661	2	5.00	8
Southern Tonle Sap	178 131	54.29	9 184 104	6 222	4.37	28 698
Northern Tonle Sap	1 054 861	15.73	2 975 064	3 851	4.42	16 720
Upper Mekong	164 755	31.24	6 322 028	14 736	4.35	62 740
Lower Mekong	291 318	8.82	18 990 382	254 116	4.45	1 123 063
Coastal	56 183	15.61	6 971 484	10 073	4.54	46 798
Total	**1 745 673**	**21.02**	**44 444 723**	**48 167**	**4.52**	**213 004.46**

In regards to income, farmers in the Lower Mekong region generate approximately USD 1 123 063 which is sourced mainly from Tbong Khmum, while farming household from the Upper Mekong region could generate USD 62 740 which is sourced mainly from Stung Treng. Farmers in the Coastal and Southern regions earned from industrial crops around USD 46 798 and USD 28 698, respectively, which locates mainly in Preah Sihanouk and Kampong Speu. Farming households in the Upper Mekong and Northern Tonle Sap region could generate between USD 1 262 to USD 1 794 per annum from industrial crops, see Table 35.

Water irrigation estimation for industrial crops is not yet identified by any public, private and civil society organization. Therefore, it needs further investigation.

TABLE 36: IRRIGATED RICE LANDS BY REGIONS

Region	Irrigated rice field	
	Rainy season (ha)	Dry season (ha)
Phnom Penh	1 870	1 076
Southern Tonle Sap	220 656	99ì 074
Northern Tonle Sap	140 953	101 041
Upper Mekong	12 601	13 402
Lower Mekong	106 638	196 315
Coastal	30 123	5 892
Total	**512 841**	**416 800**

The socioeconomic assessment of the six regions indicates that several areas have a high number of water consuming establishments such as pure water stations, hotels, and guesthouses (Figure 45). The Lower

Mekong region has most pure water stations (486 places), followed by the Northern Tonle Sap (366 places), and the Southern Tonle Sap (355 places). Most hotels locate in the Northern Tonle Sap (291 places), followed by Phnom Penh (287 places).

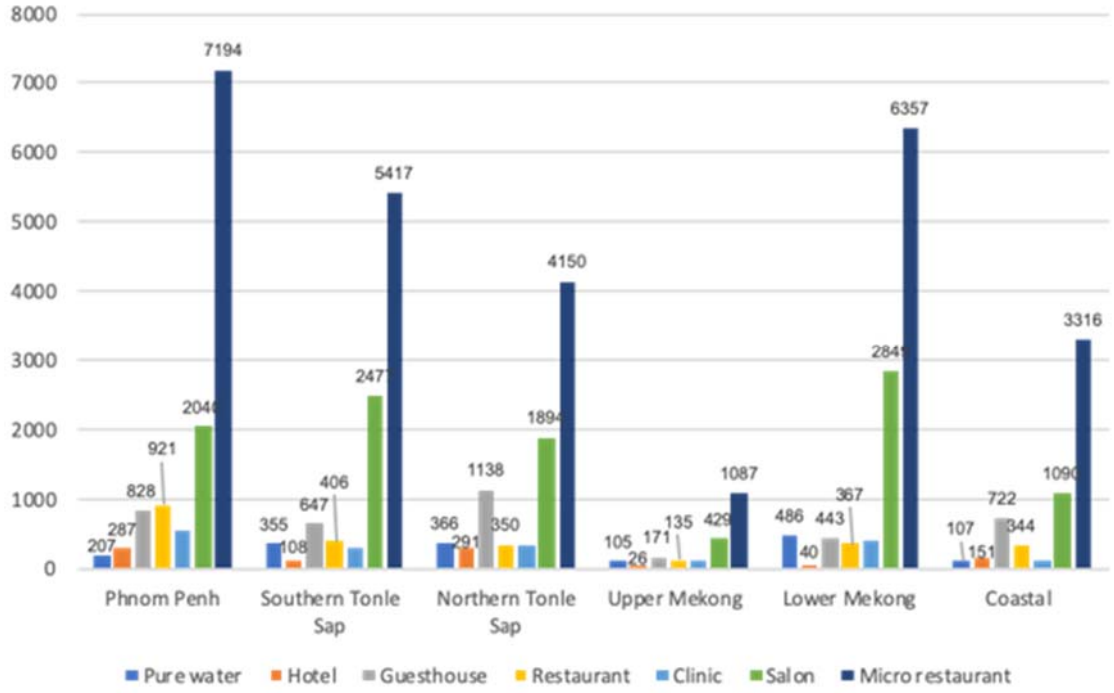


FIGURE 45: COMPARISON EXISTING BUSINESS ESTABLISHMENTS FROM THE SIX REGIONS (SOURCE: CREATED BY AUTHORS)

Schools are considered the highest water users of public administration as it consists of public hygiene toilets and cleaning activities. In this category the Lower Mekong region indicates the highest water use, followed by the Southern Tonle Sap regions (Figure 46).

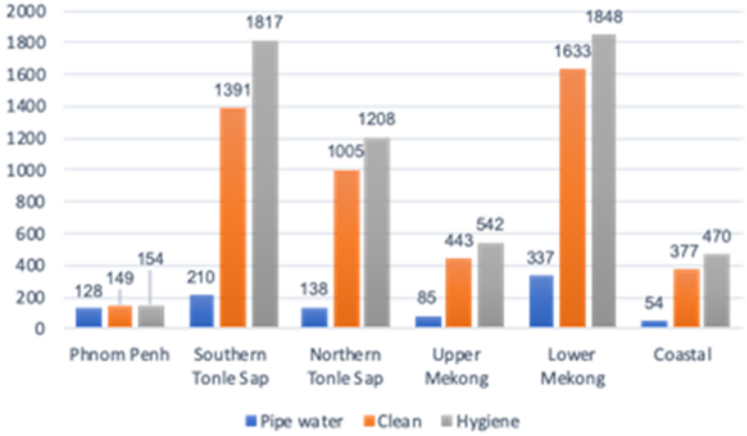


FIGURE 46: SCHOOL ACCESS TO WATER AND SANITATION FROM THE SIX REGIONS (SOURCE: CREATED BY AUTHORS)

Table 37 shows the number of wells highlighting the groundwater dependency of communities in Prey Veng and Svay Rieng, as well as Siem Reap, which have already been discussed.

TABLE 37: NUMBER OF WATER SOURCES BY PROVINCES

List	Region	Tube well	Well	Pond
1	Phnom Penh	7 544	1 387	62
2	Pursat	9 503	6 751	3 838
3	Kampong Chhnang	36 859	14 504	180
4	Banteay Meanchey	10 944	3 040	9 038
5	Kampong Speu	10 345	4 125	1 354
6	Pailin	403	269	521
7	Battambang	19 990	6 863	13 545
8	Siem Reap	96 729	16 886	2 151
9	Kampong Thom	25 634	40 262	1 935
10	Kampong Cham	44 065	25 623	372
11	Udor Meanchey	3 233	2 196	1 153
12	Kratie	5 705	5 045	246
13	Preah Vihear	10 549	2 867	682
14	Stung Treng	1 322	1 266	226
15	Kandal	26 865	5 199	401
16	Takeo	32 991	6 858	4 431
17	Svay Rieng	120 847	668	558
18	Prey Veng	186 665	1 721	29
19	Tbong Khmum	83 074	23 913	90
20	Kampot	16 915	11 345	2 409
21	Koh Kong	995	3 962	309
22	Preah Sihanouk	3 719	7 522	70
23	Kep	679	1 142	219
Total		**755 575**	**193 414**	**43 819**

Annex M7: Socio-economic assessment for Viet Nam's Mekong Delta

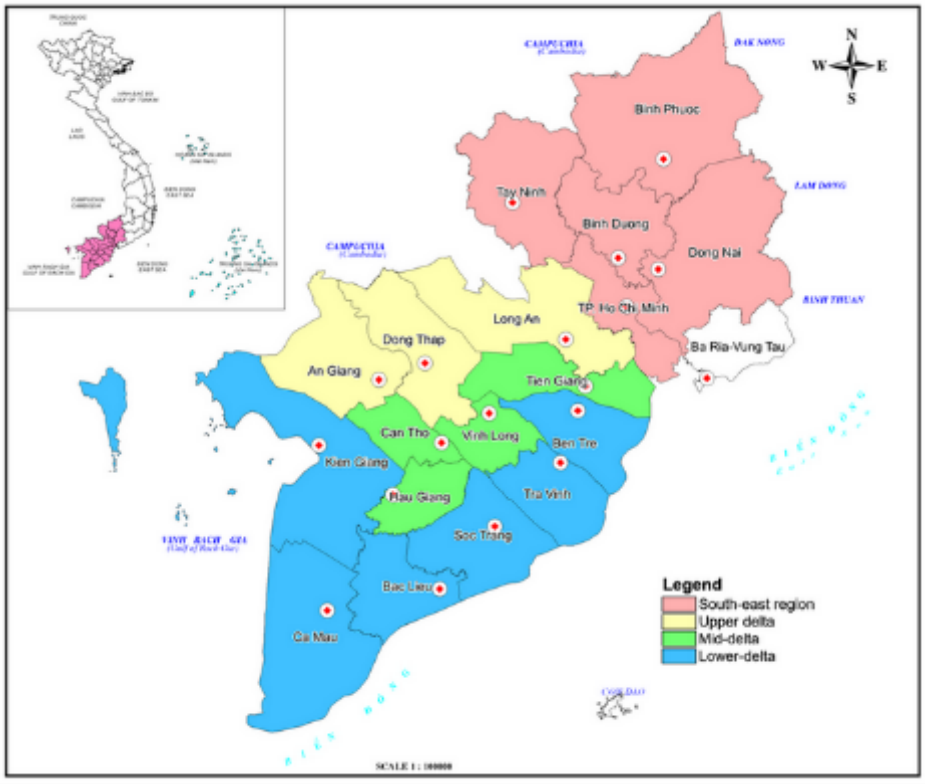


FIGURE 47: MAP SHOWING THE SOUTH EAST REGION AND VIET NAM'S MEKONG DELTA. PROVINCES/CITIES ARE GROUPED BY GEOGRAPHICAL AND AGRO-ECOLOGICAL FEATURES: (1) SOUTH EAST REGION (PINK), (2) UPPER DELTA (LIGHT YELLOW), (3) MID-DELTA (LIGHT GREEN) AND (4) LOWER DELTA (LIGHT BLUE) (SOURCE: OWN MADE FOR THIS INTERNAL REPORTS ONLY). (SOURCE: CREATED BY AUTHORS)

Agricultural and forest land covers

Agricultural land covers strongly affect aquifers systems through groundwater abstraction and recharge. The land covers and their trends differ with geographical and agro-ecological zones. In the SE region, land surface devoted to agricultural production and forestry shares an average of 58 percent and 21 percent of total land surface. Binh Phuoc province shared about 36 percent of total agricultural and forest land surface, and Dong Nai province contributed to 40 percent of total forest surface in the SE region, and Dong Nai. In the VMD, the upper- and mid-delta zones devoted an average of 75 – 77 percent of total land surface; the respective figure of the lower zone was 54 percent (Table 1). Agricultural land cover ratios are relatively low with Bac Lieu and Ca Mau provinces, a low-lying area. The share of forest land to total surface is lower in the MD than in the SE region. The VMD is characterized as a wetland region with an elevation below 3.0 m above the mean sea level, which is lower than that of the SE region. Sustainable management of agricultural and forest land is of importance to aquifer recharge.

Agricultural and forest land surface gradually shrank from expansion of urban and industrial land, and deforestation**.** In the SE region, the decline of agricultural land surface occurred in all provinces, with an average of 3 percent per year. The significant decline occurred with Dong Nai province and Ho Chi Minh city. However, (planted) forest land grew with an annual average of 1.3 percent. Forest land in Binh Phuoc and Tay Ninh provinces grew relatively faster while that in Ho Chi Minh city declined from urbanization and transportation infrastructure development. In the VMD, agricultural land did not change much in the upper- and the mid-delta, except for Can Tho, while it gradually declined in the lower delta. Agricultural land devoted 1 percent per year for urbanization and industrialization in Can Thơ city in the period of 2005 – 2018. *S*wampy forest surface reduced by about 6 percent per year in the upper- and mid-delta, and about 0.2 percent in the coastal delta. In

the upper- and mid-delta zones like Long Xuyen Quadrangle and the Plain of Reeds, natural wetland areas significantly declined from rice production development, water management structure and transportation system development, and human settlement (Giri et al., 2003; Prabaharan et al., 2010; Sohail, 2012; Hoang Nguyen Huu, 2017). The gradual shrink of wetland lands and the urbanization lead reduced potential recharge into aquifer systems while urbanization and agricultural development increased demands for groundwater uses.

Rice and shrimp development were the main cause of changes in agricultural and natural forest land (Binh et al., 2005). The studies applied GIS and remote sensing techniques to analyze land use dynamics of the Mekong Delta. Liu et al (2020) reveal land use change with an average rate of 2.1 percent per year in the period of 1979 - 2015. Mangrove forest areas was converted into to rice land, mainly before 1999, and into shrimp farming land since 2000. Aquaculture area grew an average of 20 000 ha per year in between 1979 and 2015.

TABLE 38: AGRICULTURAL AND FOREST LAND IN 2018 AND ANNUAL GROWTH RATE (%) IN THE PERIOD 2005 – 2018 BY PROVINCE/CITY IN THE SE AND VMD REGIONS

Provinces/ cites[1]	Total area (10^3 ha)	Agricultural land			Forest land		
		Area (10^3 ha)	Share (%)[2]	Growth (%/year)	Area (10^3 ha)	Share (%)[2]	Growth (%/year)
South-east region							
Binh Phuoc	688	445	64.8	-2.9	160.7	23.4	1.8
Tay Ninh	404	270	66.9	-2.1	65.7	16.3	3.4
Binh Duong	270	194	72.0	-1.0	10.0	3.7	0.7
Dong Nai	586	277	47.2	-4.4	182.7	31.2	0.8
Ho Chi Minh (HCMC)	206	66	31.8	-5.1	33.5	16.3	-1.3
Subtotal	*2,154*	*1,252*	*58.1*	*-3.0*	*452.6*	*21.0*	*1.3*
Upper (flood-prone) delta							
Long An	450	317	70.6	0.1	22.5	5.0	-8.2
Dong Thap	338	260	76.9	0.2	6.1	1.8	-4.6
An Giang	354	283	79.9	0.7	13.7	3.9	-0.2
Subtotal	*1,142*	*860*	*75.3*	*0.3*	*42.3*	*3.7*	*-5.9*
Mid-delta							
Tien Giang	251	179	71.4	0.0	2.6	1.0	-11.0
Vinh Long	153	120	78.4	0.3	0.0	0.0	-
Can Thơ	144	112	78.0	-0.1	0.0	0.0	-
Hau Giang	162	136	83.7	0.2	3.1	1.9	4.0
Subtotal	*710*	*547*	*77.1*	*0.1*	*5.7*	*0.8*	*-6.4*
Lower (coastal) delta							
Ben Tre	240	140	58.6	-0.7	4.2	1.8	1.1
TraVinh	236	148	62.6	-1.0	9.0	3.8	3.1
KienGiang	635	463	72.9	0.7	70.5	11.1	-0.6
SocTrăng	331	213	64.2	-1.0	11.1	3.4	1.2
Bac Lieu	267	102	38.1	-3.6	4.7	1.8	-2.1
Ca Mau	522	143	27.4	-4.2	95.5	18.3	-0.1
Subtotal	*2,230*	*1,209*	*54.2*	*-1.1*	*195.0*	*8.7*	*-0.2*
Total	*6,236*	*3,867*	*62.0*	*-1.2*	*701.9*	*11.3*	*0.1*

[1] *Grouped by geography and agro-ecology;* [2] *% of total natural surface area (%); Source: own calculations based on GSO (2007 - 2020)*

Rice production

Rice production is closely associated with wetland management, which is relevant to aquifer recharge. Rice production is a major farming activity in the VMD and the secondary to the SE region (Fig. 3). In the SE region, rice is mainly grown in Tay Ninh and Dong Nai provinces, account for about 85 percent of total rice land, relying on irrigation from Vam Co and Dong Nai rivers and Dau Tieng reservoir, while in the others rice cropping highly relied on rainwater. In 2019, the total rice grown area in the SE region accounted for about 6 percent of total grown area in both regions. The upper- and lower delta dominated rice production area, practicing two or three crops per year. Among the lower provinces, Kien Giang and Soc Trang provinces are considered "key rice producing provinces", where triple rice cropping has been commonly practiced.

The trend in rice grown area differed with zone and time. In the SE region continuously dropped, from 373 000 ha in 2000 to 243 000 ha in 2019 (Fig. 3a). The mid-delta had the same trend, whereas, in the upper- and lower delta, it continuously grew in the period of 1995 – 2015 and declined then. The growth of rice area in the upper- and lower delta mainly came from the development of triple rice cropping (Sakamoto et al., 2009), to which the third rice crop (autumn – winter crop) is practiced during monsoon flood periods of the Mekong by flood control structure systems. Triple rice cropping area grew continuously in the period 1995 – 2015 (Fig. 3b).

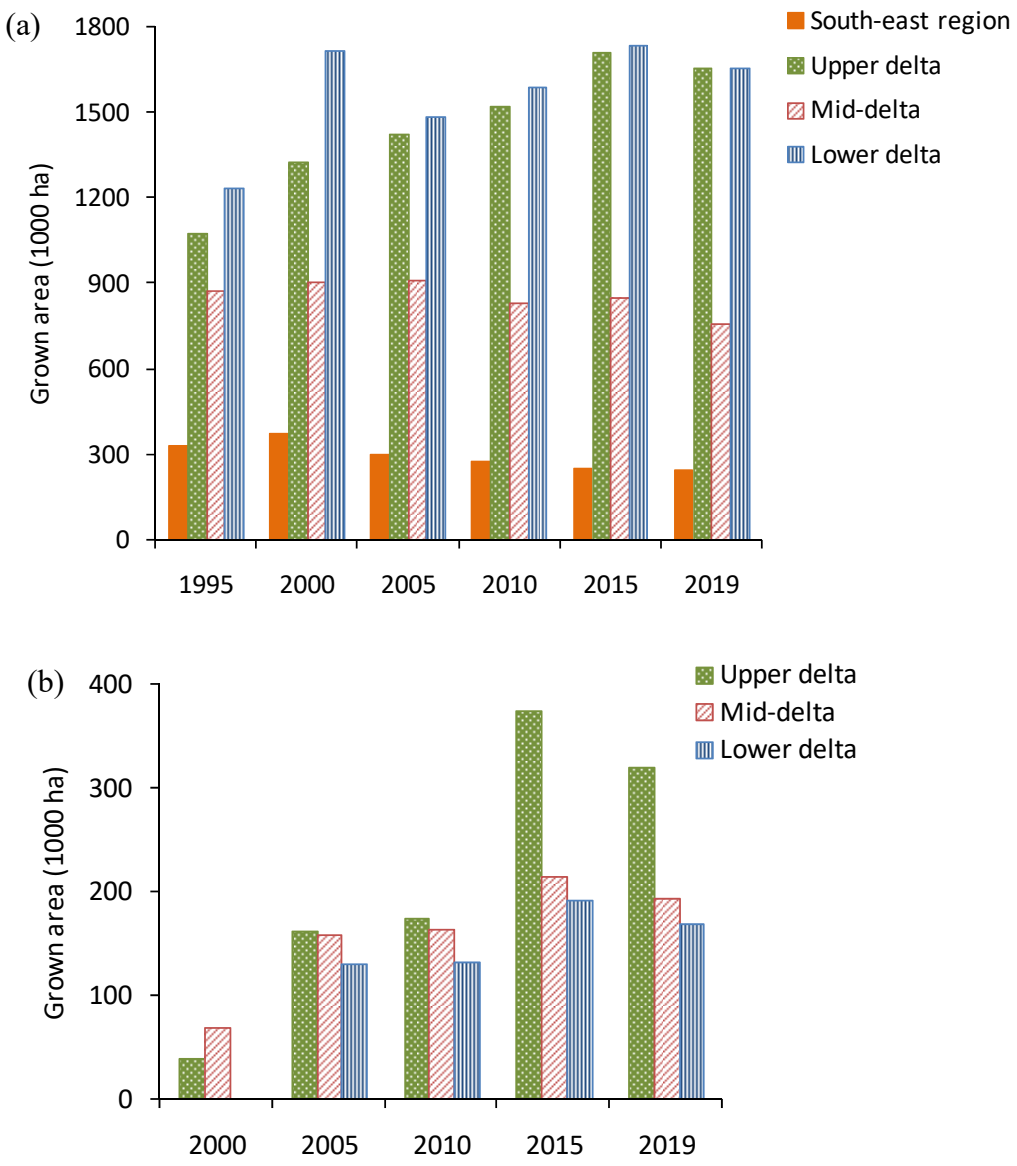


FIGURE 48: RICE GROWN AREA IN THE PERIOD OF 1995 – 2019 BY REGION: (A) ALL RICE CROPS COMBINED AND (B) THE AUTUMN – WINTER CROP (SOURCE: CREATED BY AUTHORS BASED ON GSO 1997 – 2020)

In the upper and mid-provinces, triple rice cropping area increased from 110 000 ha in 2000 to 610.000 ha in 2016. The decline of rice grown area was due to the shift of rice to other crops with higher income (e.g. fruits, annual upland crops or shrimp) or shifting triple rice to double rice cropping with higher rice quality and value. Rice farming shift in the VMD has commonly taken place since 2017, from serious crop damage by the extreme drought and salinity intrusion from estuary in 2016. Rice land uses and farming shifts in the delta are closely relevant to aquifer recharge and groundwater use for crop irrigation (see following sections).

Upland crop production

Upland crop production in rain-fed areas of the SE region and the lower delta totally depends on groundwater in the dry season. Upland crops include annual vegetables and cereals and perennial crops (i.e. fruits, pepper, coffee and cashew). In 2019, the mid- and lower delta had larger area of annual crops than the SE region and the upper delta, while the SE region practiced perennial upland crops in larger area (Fig. 4). In the lower delta, farmers commonly grow annual upland crops on sandy soils (i.e. sandy terraces parallel to coast lines) in Ben Tre, Tra Vinh, Soc Trang and Bac Lieu provinces, where farmers extract groundwater from wells (i.e. 15 – 120 m deep) to irrigate the crops in the dry season. Fruits are commonly practiced in Binh Duong and Tay Ninh provinces while the others (pepper, coffee and cashew) dominate in Binh Phuoc and Dong Nai provinces.

Annual upland crop area gradually grew in the last decade, except for the upper delta (Fig. 4a). Perennial upland crop area tended to increase in the upper- and mid-delta (Fig. 4a). In the coastal delta, farmers there have shifted double rice cropping to annual upland crops with short-growth duration in the dry season, in rotating with rice in the rainy season. The development of upland crops in the SE region and the lower delta required more groundwater for irrigation.

Aquaculture

Aquaculture sector is minor in the SE region while it is an important economic activity in the VMD. The lower delta had large area of aquaculture, mostly shrimp farming, while the upper- and the mid-delta commonly practiced freshwater fish (i.e. *Pangasius* catfish) (Fig. 5). Shrimp farming systems include semi-intensive shrimp mono-culture year-round (2 – 3 crops/year) in saline water zone (saline period > 9 months) and shrimp in the dry season that is rotated with rice cropping in the rainy season (saline period = 5 – 7 month). The upper- and mid-delta produced a large fish production from intensive culture systems (Fig. 5b).

Freshwater fish growing area in the upper- and mid-delta slowly grew while shrimp culture area in the coastal delta expanded fast in the last two decades. In the period of 1995 – 2019, aquaculture sector annually grew 2-5 percent in area and 10 – 13 percent in production, implying increasing intensification level. Growing shrimp in the lower delta, in some cases farmers extracted groundwater with low salinity level to dilute saline water in ponds when salinity concentrations are too high during hot months in the dry season. Otherwise, they use saline groundwater to grow shrimp when salinity level of surface water is too low for shrimp. Under the pressure of salinity intrusion and agricultural transformation, further expansion and intensification of aquaculture production in the coastal delta without appropriate intervention would negatively impact the groundwater resource in the VMD.

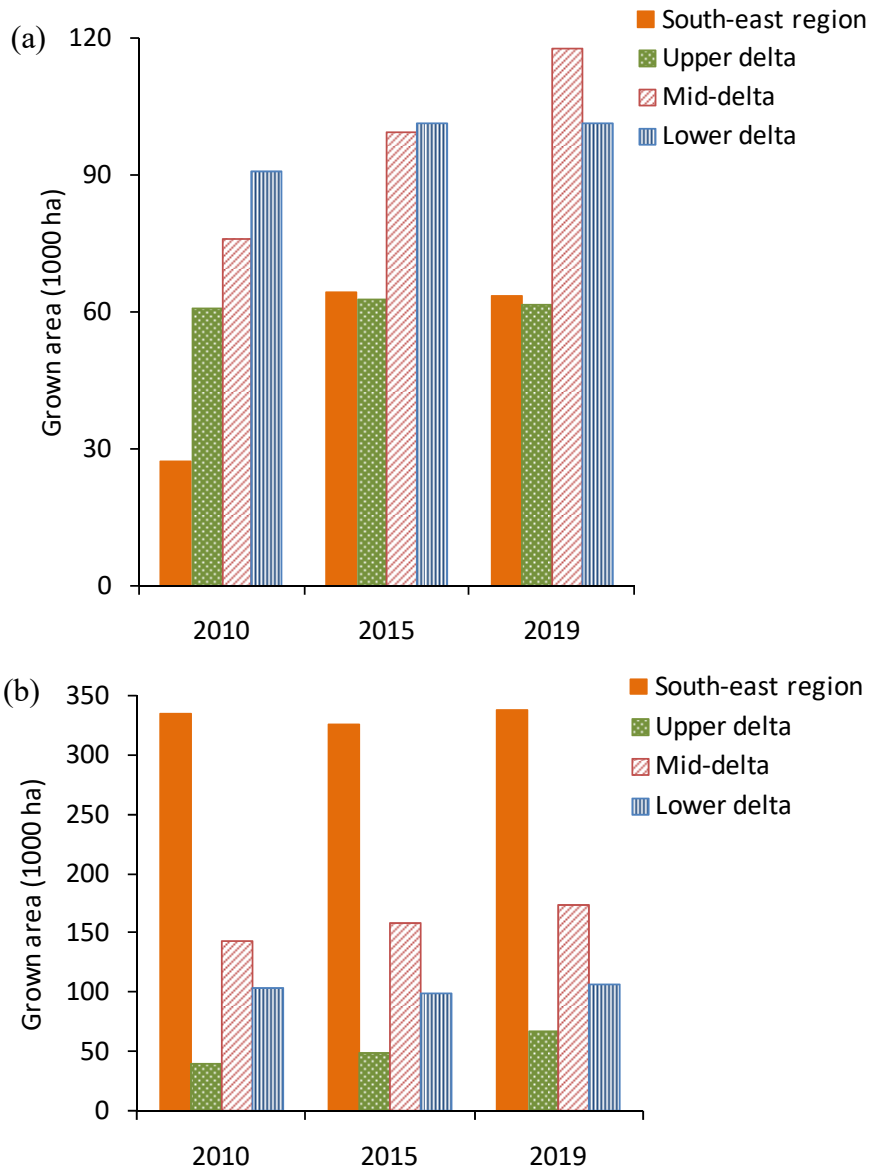


FIGURE 49: GROWN AREA IN THE PERIOD OF 2005 – 2019 BY REGION: (A) ANNUAL UPLAND CROPS AND (B) PERENNIAL FRUITS (SOURCE: CREATED BY AUTHORS BASED ON GSO 2007 – 2020)

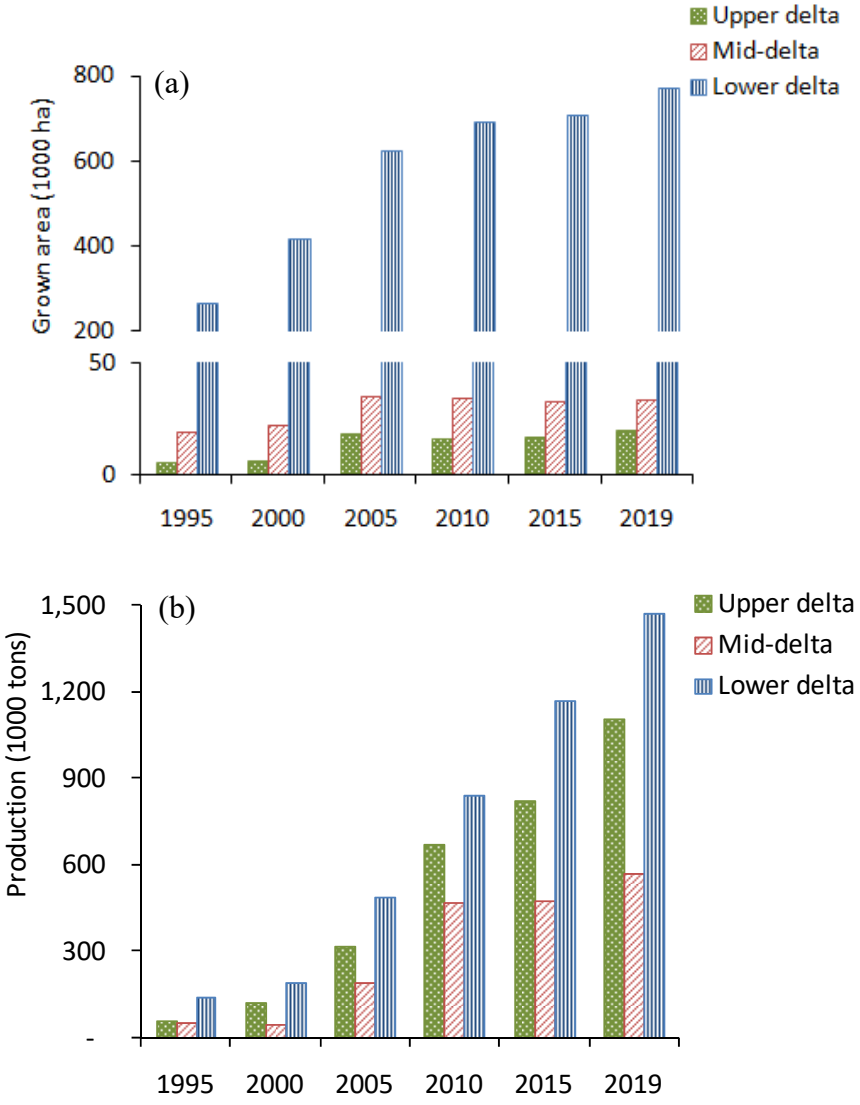


FIGURE 50: AQUACULTURE AREA (A) AND PRODUCTION IN THE PERIOD OF 1995 – 2019 BY REGION (SOURCE: CREATED BY AUTHORS BASED ON GSO 1997 – 2020)

Livestock production

Livestock production is an important agricultural sector in both the SE and VMD regions. In 2019, the SE region produced 34 percent and the mid- and lower delta produced 48 percent of total poultry production in both regions (Fig. 6a). Poultry production grew continuously after a bird flu outbreak in 2004 – 2005. For pig production, the SE region, the mid-delta and the lower delta produced 44 percent, 21 percent and 24 percent of total pig production in the two regions (Fig. 6b). Pig production did not grow stably. It did not change much with the SE region and has tended to decline since 2010 with the VMD, due to an extensive African Swine Fever outbreak. For cattle, the SE region and the lower delta dominated cattle production, accounting for 30 percent and 36 percent of total number of heads (Fig. 6c). Total numbers of cattle in the SE region went down in the last decade while they gradually grew up in the VMD. Cattle production would be a promising sector in the VMD in the future under rice production shift and projected droughts and salinity intrusion.

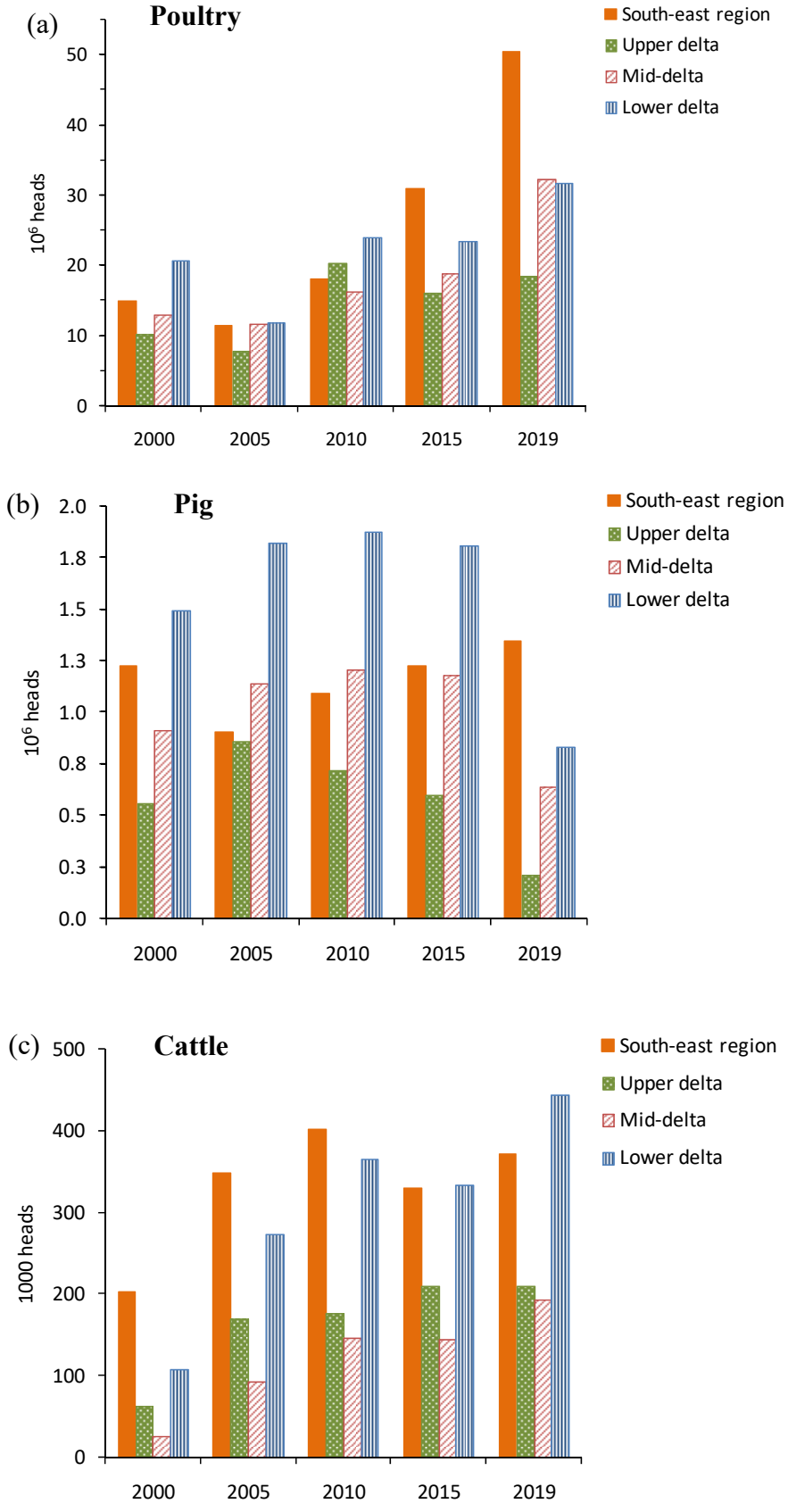


FIGURE 51: LIVESTOCK PRODUCTION IN THE PERIOD OF 2000 – 2019 BY REGION: (A) POULTRY, (B) PIG AND (C) CATTLE (SOURCE: CREATED BY AUTHORS BASED ON GSO 2002 - 2020)

Livelihoods

Poverty status

Viet Nam has applied multidimensional poverty index to assess poverty of households through five basic dimensions: health-care, education, housing, water and sanitation, and information access (Decision 59/2015/QĐ-TTg, dated November 19th 2015). Accordingly, about 20 200 households in the SE region (excluding Ho Chi Minh city) and 235 300 households in the VNM are considered poor in 2019 (Table 39). Among the SE region, Binh Phuoc and Tay Ninh provinces had a relatively higher poverty rate (3.7 percent and 1.2 percent, respectively), compared to the others (< 0.7 percent). In the VMD, the lower delta had a relatively higher poverty rate than the upper- and mid-delta. The former contributed about 22 percent of total households but shared about 49 percent of total poor household in both SE and VMD regions. Tra Vinh, Bac Lieu and Ca Mau provinces were the top three provinces of high poverty rate.

TABLE 39: RESOURCE-POOR HOUSEHOLDS (HHS) AND THEIR LACK OF ACCESS TO CLEAN WATER BY REGION IN 2019

Regions/zones	Poor HHs		Poor HHs lacking access to clean water	
	Count (10^3 HHs)	%	Count (10^3 HHs)	%
South-east region[1]	20.2	1.2	1.7	8.5
Upper delta	59.8	4.1	9.3	15.5
Mid-delta	50.5	3.7	18.1	35.8
Lower delta	125.0	6.3	13.9	11.1
Total	255.5	2.8	42.9	16.8

[1] excluding Ho Chi Minh city
Source: Calculated from MOLISA (2020) and GSO (2020)

Average poverty rates of all the zones continuously decreased in the period of 2010 – 2019 (Figure 52). The VMD, especially the lower delta, had a relatively higher poverty rate in the late decade. Poverty rates annually dropped an average of 11 percent with the SE region and 8-9 percent with the VMD. The poverty rate exceptional increased in 2016 due to the assessment applying multidimensional poverty indicators.

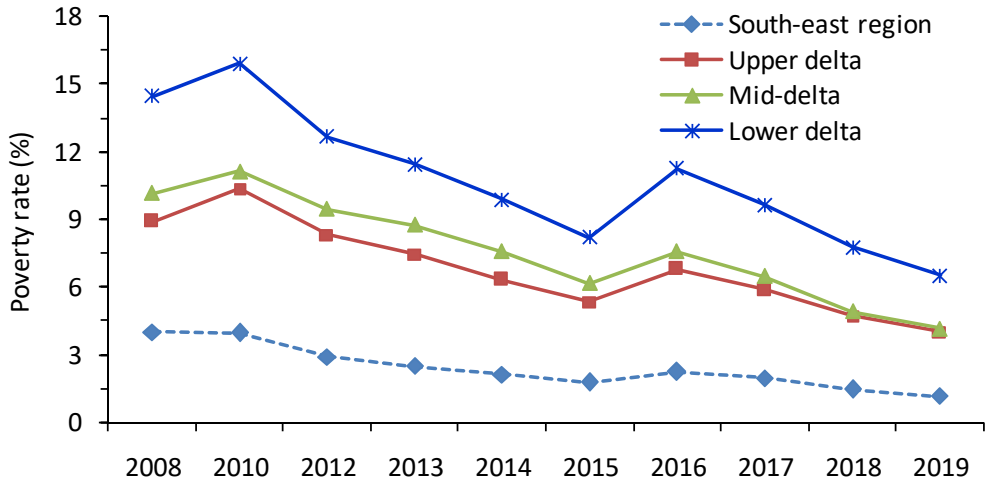


FIGURE 52: AVERAGE POVERTY RATES IN THE PERIOD OF 2008 – 2019 BY REGION (SOURCE: CREATED BY AUTHORS BASED ON GSO, 2020)

Access to clean water

There were about 42 900 resource-poor households poorly access to clean water for domestic uses in both SE and the VMD regions (Table 2). The SE region shared only about 4 percent of poor households without sufficient access to clean water and sanitation. The respective figures were 42 percent and 32 percent with the mid- and lower delta.

There is a need of improved access to clean water supply systems for drinking. About 63 percent and 45 percent of total households in the SE and the VMD, respectively, accessed to tap water systems (Fig. 8). About 1.3 and 1.2 millions houselhods in the SE and the VMD regions, respectively, used groundwater from individual deep wells for drinking. Still about 1.5 millions households had drinking water from rains and/or rivers/canals. More households accessed to tap water systems in the last decade in both regions. The proportion of households abstracting groundwater from individal wells for drinking dropped in the SE region in the period 2008 – 2018. The contrary occured in the VMD, where many people in coastal areas have dealt with surface water pollution and salt water intrusion from the sea in the dry season. The proportions of households relying on water from rains and/or river/canal for drinking decreased in the last decade. There were still households using surface water from canals/rivers for bathing and washing while piped water for cooking and drinking (Thai and Guevara, 2019).

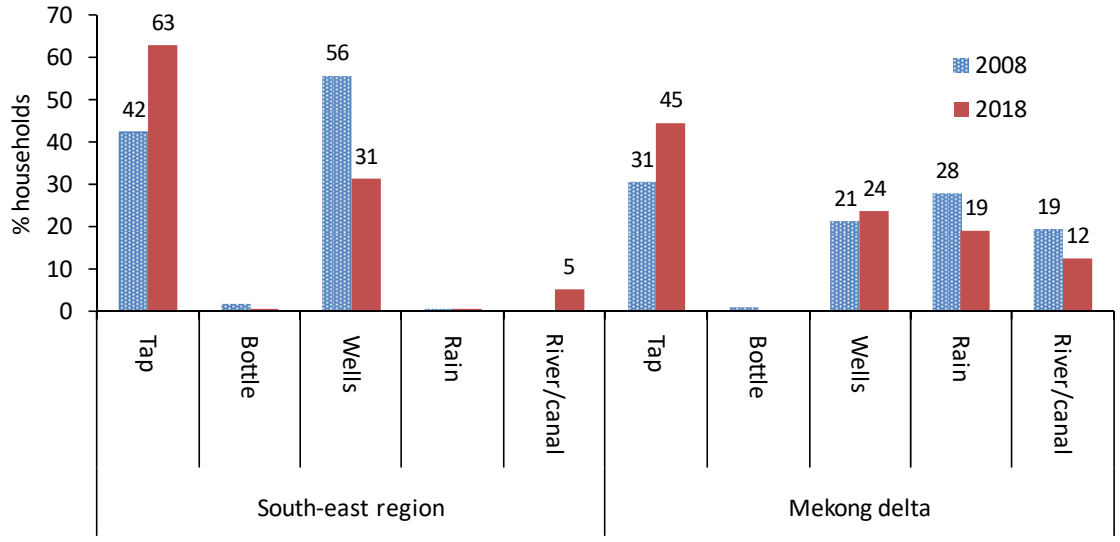


FIGURE 53: PROPORTIONS OF HOUSEHOLDS ACCESSING TO DRINKING WATER SOURCES BY REGION IN 2008 AND 2018 (SOURCE: CALCULATION BASED ON GSO, 2019).

In the VMD, groundwater quality usually does not meet Viet Nam's and WHO standards for domestics uses (Buschmann et al. 2008; Erban et al. 2013; Merola et al. 2015). Most of households in rural and salinity-affected areas use groundwater directly or with simple treatments for daily domestic purpose, due to unavailability and/or poor quality of surface freshwater. Better-off households usually use bottled water drinking. For example, in the Plain of Reeds (the upper delta), an estimate of only 16 percent of water users access to "clean" groundwater, based on the Viet Nam's standard, from communal water supply stations (based provincial DARD, unpublished data). Households that cannot access to communal water supply systems use water directly from individual tube-wells without any treatments.

The use of rain water for domestic and agricultural purposes is still not popular, due to storage capacity and quality problems. A majority of groundwater users for domestic and crop irrigation purposes use privately owned tube-wells, which constraint in improving water quality, use efficiency and use management. Improved

access to communal groundwater supply stations is therefore necessary to switch from private wells to communal supply systems (Danh and Khai, 2015).

Food consumption, employment and capacity

The VMD produced surplus food for domestic consumption. Per capita cereal production (including rice, corn and beans) exceeded 1000 kg/year in the last decade (Figure 54). The figures was higher in the upper delta than the mid- and lower delta, due to high rice production volumes. Annual cereal production per capita continuously increased in the last decade and has tended to decrease since 2018, due to the reduction of rice grown area as the promotion by the Goverment. Per capita cereal production in the SE region was lower than that in the VMD and did not change much during the late decade.

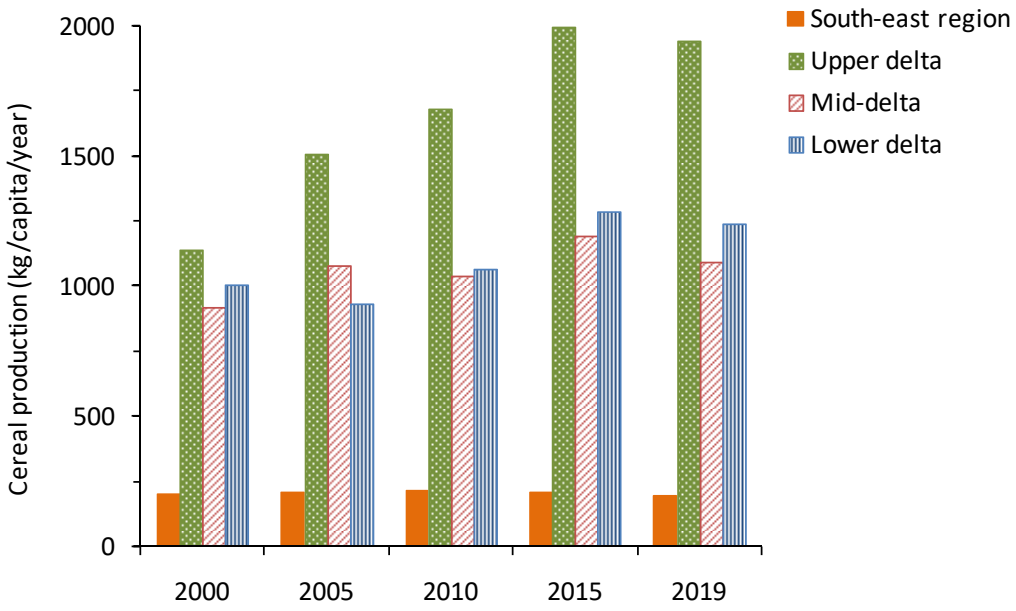


FIGURE 54: AVERAGE PERCAPITA CEREAL PRODUCTION IN THE PERIOD OF 2000 – 2019 BY REGION (SOURVE: CREATED BY AUTHORS BASED ON GSO 2002 - 2020)

Rice, vegetables, fruits and meat were basic food (Table 40). In 2018, people in the SE region consumed an average of 7.0 kg of rice and other cereals, 3.1 kg vegetable and fruits, 2 kg of meat and 1.4 kg of fish. People in the VMD ate more rice and fish and less vegetables, fruits and eggs. In both region, people tended to to less cereals, vegetables and fruit, and and more meat or eggs.

TABLE 40: MONTLY AVERAGE CONSUMPTION PER CAPITA OF MAIN FOODS BY REGION IN 2008 AND 2018

Food types	South-east region		Mekong Delta	
	2008	2018	2008	2018
Rice (kg)	8.3	6.1	10.9	8.4
Other cereals (kg)	1.2	0.9	0.7	0.7
Vegetables & fruits (kg)	3.6	3.1	2.7	2.5
Meat (kg)	1.8	2.0	1.2	1.9
Fish (kg)	1.5	1.4	2.4	2.3
Eggs (eggs)	4.1	4.0	2.4	3.6

Source: Based on Viet Nam Household Living Standard Surveys by GSO (2020)

Employment and work skill

The labor force employed against the total working-age population differs with region and sex. The employment labour rates of the VMD were higher than that in the SE region (Figure 55). The employment rate was higher with male than female labourers. The employment rates of female workers both regions were lower than the average country figures. Rural working-age women usually do daily housework and likestock production (Truong Thi Ngoc Chi et al., 2019), to which are closely related to groundwater uses (Figure 53). About 34 percent of female labour participates in daily houseworks, compared with about 3 percent of male.

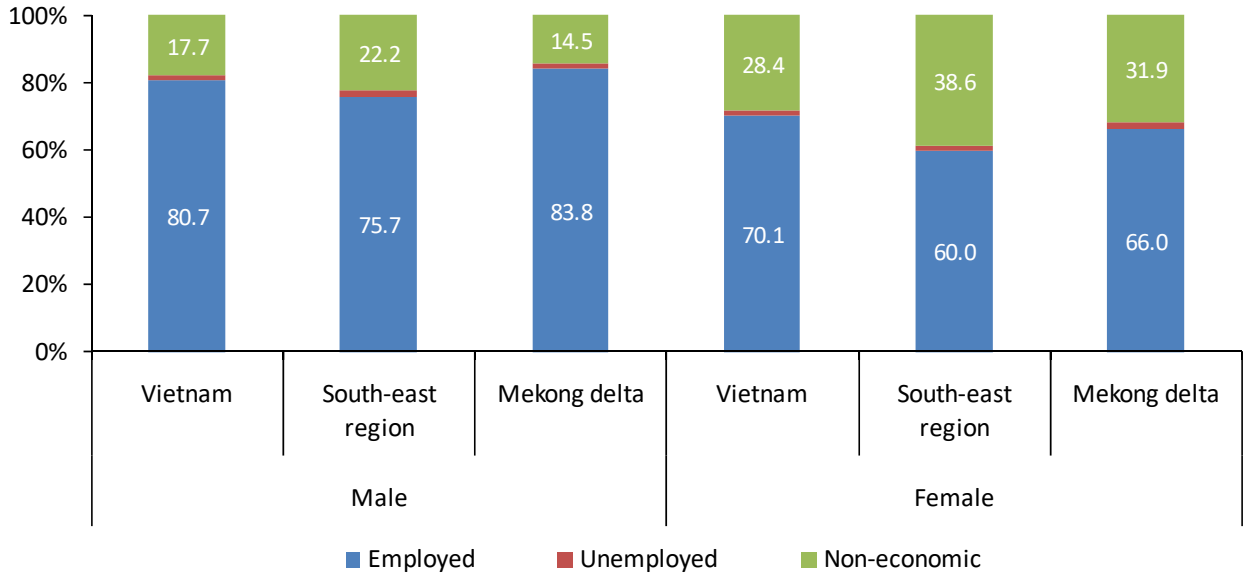


FIGURE 55: STRUCTURE OF POPULATION FROM 15 YEARS OLD AND ABOVE BY ECONOMIC ACTIVITIES IN 2018 (SOURCE: CALCULATIONS BASED ON GSO, 2019)

Employed labour force rates with skilled occupations were low in the VMD and with woman. The proportions of skilled workers of the VMD were lower than those of the SE region and the country average (Figure 55). Labour force with skilled occupations is larger with male than female in both the SE and VMD regions as well as in Viet Nam in general. In the VMD, employed worker with skilled occupations were mainly in the upper- and mid-delta and less frequent in the lower delta (Figure 56). Skilled employment rates increased in the period 2015 – 2018. Labour force with low skills commonly occurs with agricultural sector (Figure 57). In the VMD, unskilled labour shares up to 95 percent of total labour force in agricultural sector. The respective figure for other economic sectors was below 40 percent. Therefore, there is a need for improvement of education, vocational trainings and job generation for labour force, particicularly for woman workers and agricultral sector.

Labour income

Average total income of labourer was relatively low in the VMD and with female labourers. In the VMD, labourers earned only 70 percent and 85 percent of average income in the SE region and the country average, respectively (Figure 58). Woman labourers monthly earned about 1.0 million VND lower than man. Lower labour income of women occurs with most of occupations, an average of 88 percent of income of man (Table 41).

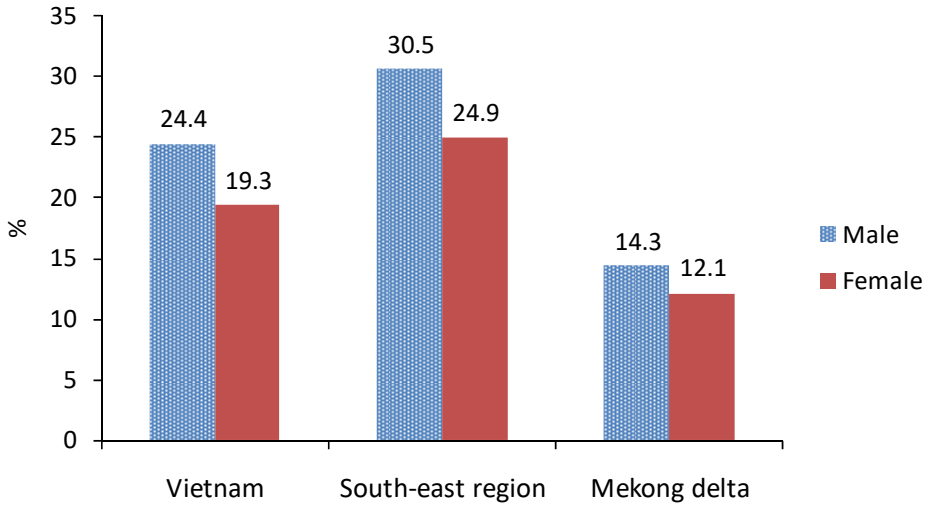


FIGURE 56: PROPORTIONS OF SKILLED LABOUR BY REGION AND SEX IN 2018 (SOURCE: CALCULATIONS BASED ON GSO, 2019)

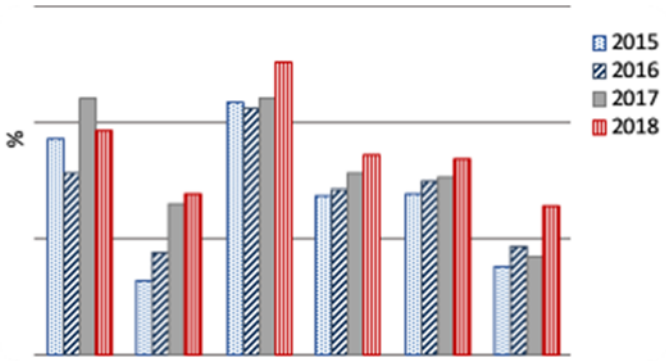


FIGURE 57: PROPORTIONS OF SKILLED LABOUR IN THE PERIOD OF 2015 - 2018 BY ZONE AND SEX (SOURCE: CALCULATIONS BASED ON GSO, 2020)

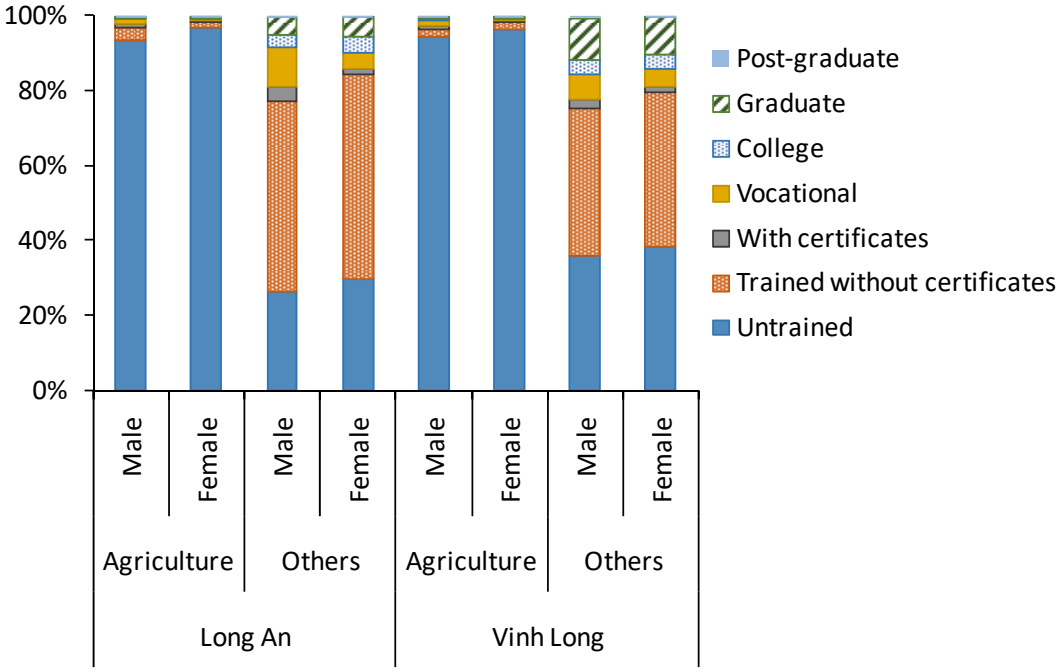


FIGURE 58: AVERAGE LABOUR STRUCTURE IN TWO PROVINCES OF THE VMD IN THE PERIOD OF 2014 – 2018 BY SKILL LEVEL AND ECONOMIC SECTOR (SOURCE: CALCULATIONS BASED ON GSO, 2016 - 2020).

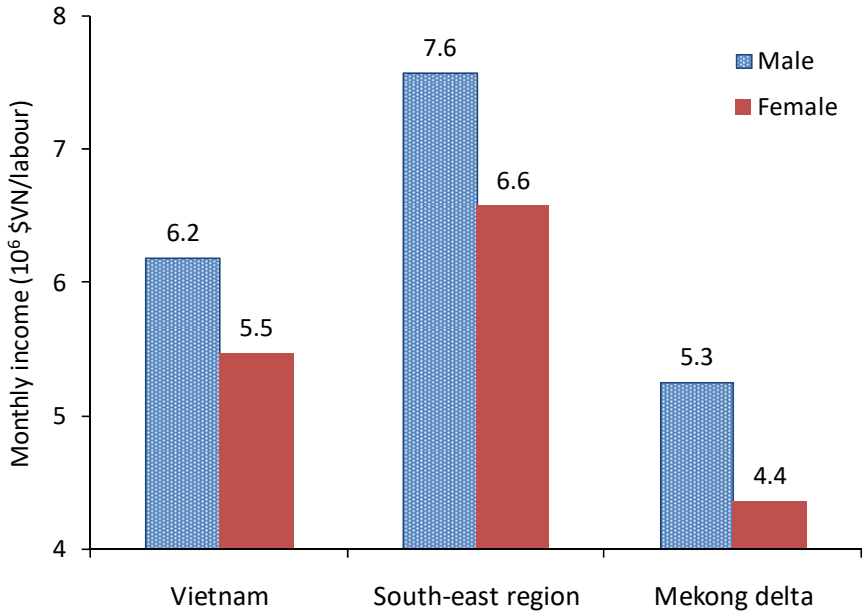


FIGURE 59: AVERAGE TOTAL INCOME OF LABOURER BY REGION AND SEX IN 2018 (MILLION VND PER LABOUR PER MONTH) (SOURCE: CREATED BY AUTHORS BASED ON GSO, 2019)

TABLE 41: AVERAGE INCOME OF EMPLOYED POPULATION BY OCCUPATION AND BY SEX IN VIET NAM IN 2018

Occupational groups	Million VND per capita per month		
	Total	Male	Female
1. Leaders, managers	9.67	10.1	8.60
2. High-level experts	8.22	9.36	7.30
3. Mid-level experts	6.36	7.07	5.83
4. Office staff	5.70	5.71	5.69
5. Service and sale staff	5.01	5.34	4.59
6. Agriculture, aquaculture, forestry	4.91	5.13	4.31
7. Manual labors and related	5.44	5.68	4.74
8. Manual assembling and operating workers	6.25	6.82	5.71
9. Low-skilled labours	4.16	4.44	3.73
Average	5.87	6.18	5.44

(Source: GSO, 2019)

Among the VMD zones, labourers in the lower delta have the lowest income (Figure 60a, b). In the VMD, the agricultural sector created 20 – 31 percent of total income, compared to only 13 percent in the SE region (Figure 60d), reflecting the reasons why work income in the VMD is relatively low. In the period from 2008 to 2018, monthly income in the agricultural sector grew by an average of 10 percent per year, compared to 16 – 20 percent in other sectors. The relative contribution to income by the agricultural sector decreased in the last decade (Figure 60c, d). Low income is one of the barriers to accessing tap water supply systems (Danh and Khai, 2015).

Population growth and rural out-migration

Population growth and urbanization level of the VMD were lower than those of the SE region. The former had annual growth rates of population and urban population of 0.3 – 0.5 percent and 1.4 – 1.7 percent, respectively, compared to 2.9 percent and 5.0 percent in the SE region (Figure 61). Among the SE provinces, Binh Duong had the highest growth rate of population and urban population. The fast growth of population in the SE region, particularly Binh Duong province, was due to high rates in in-migration (Figure 62a). The contrary occurred in the VMD provinces, where rural labor force tended to migrate to urban and/or industrial areas in the SE region for job opportunities. High out-migration rates took place in coastal provinces (Ben Tre, Tra Vinh and Kien Giang) (Figure 62b). In the lower provinces, where extreme salinity intrusions in the dry season have occured more frequent and shrimp-based farming is the main livelihood activity, more female labour out-migrated than male. The contrary occurs in the freshwater with farming diversity, including rice, fruit, vegetables, fish and livestock production (i.e. Long An, Dong Thap and An Giang provinces) (Figure 62a). Saline-based aquaculture requires lower labour inputs and is more economically risky, compared to freshwater-based farming activities.

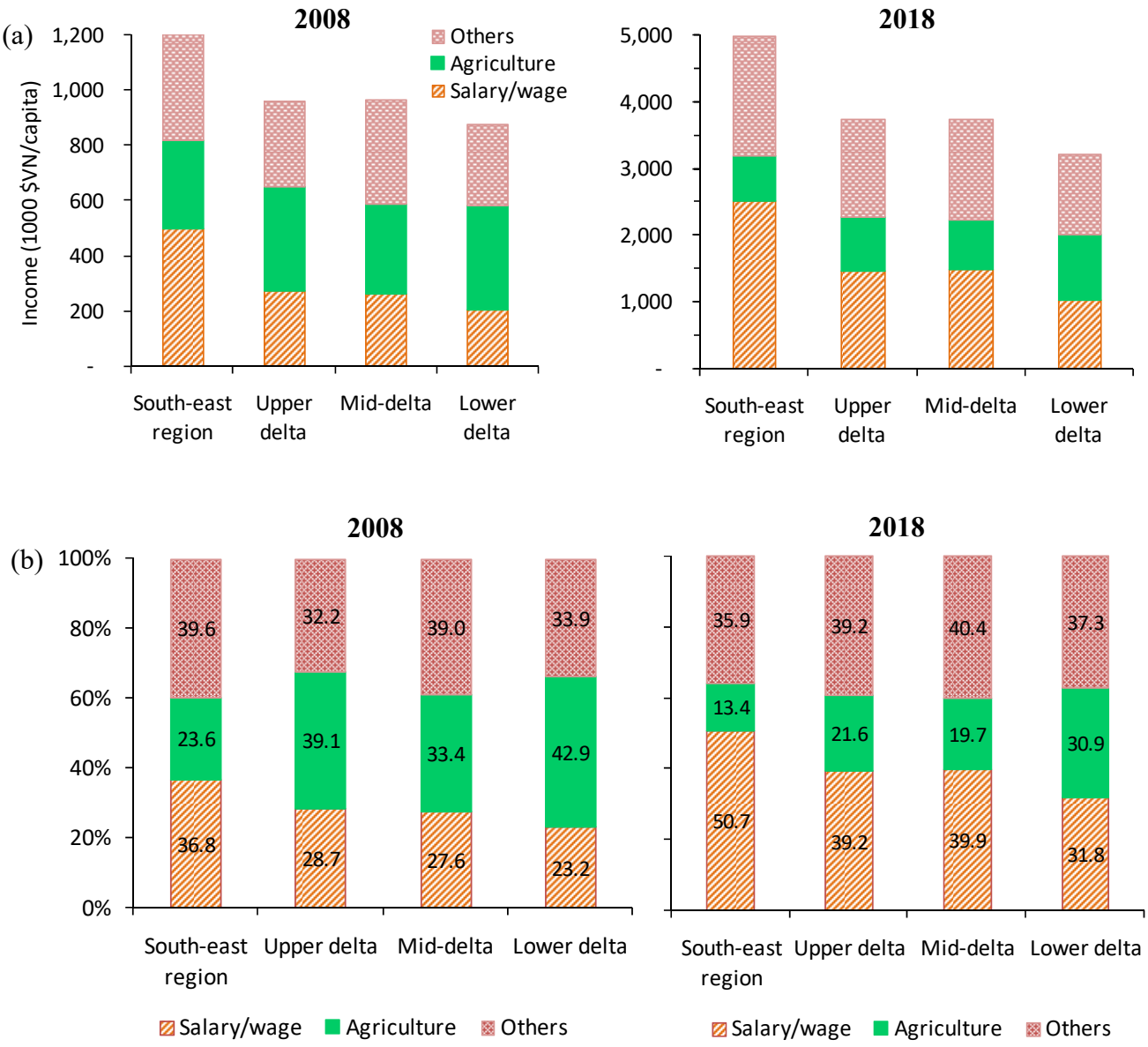


FIGURE 60: MEAN MONTHY INCOME PER LABOURER IN 2008 AND 2018 BY WORK AND REGION: (A) INCOME VALUE AND (B) INCOME STRUCTURE BY WORK SECTOR (SOURCE: CALCULATION BASED ON VIET NAM HOUSEHOLDS' LIVING STANDARD SURVEYS OF GSO, 2019)

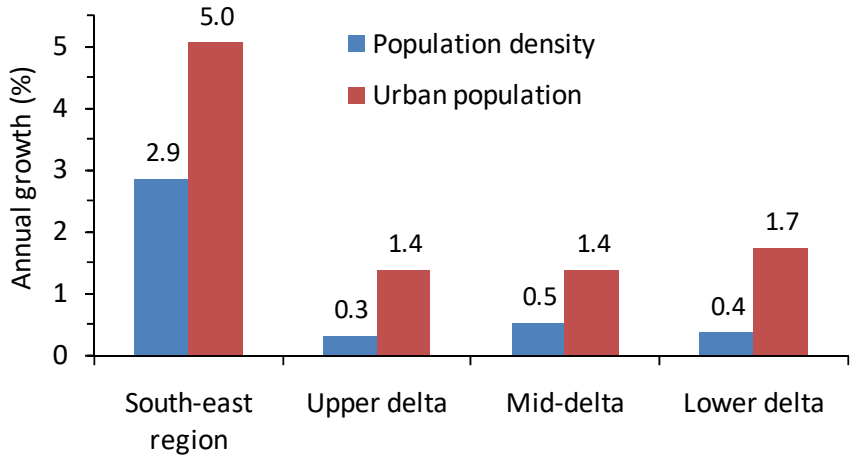


FIGURE 61: ANNUAL GROWTH RATES OF POPULATION DENSITY AND URBAN POPULATION IN THE PERIOD OF 2000 – 2019 BY REGION (SOURCE: CALCULATION FROM GSO, 2002 - 2020)

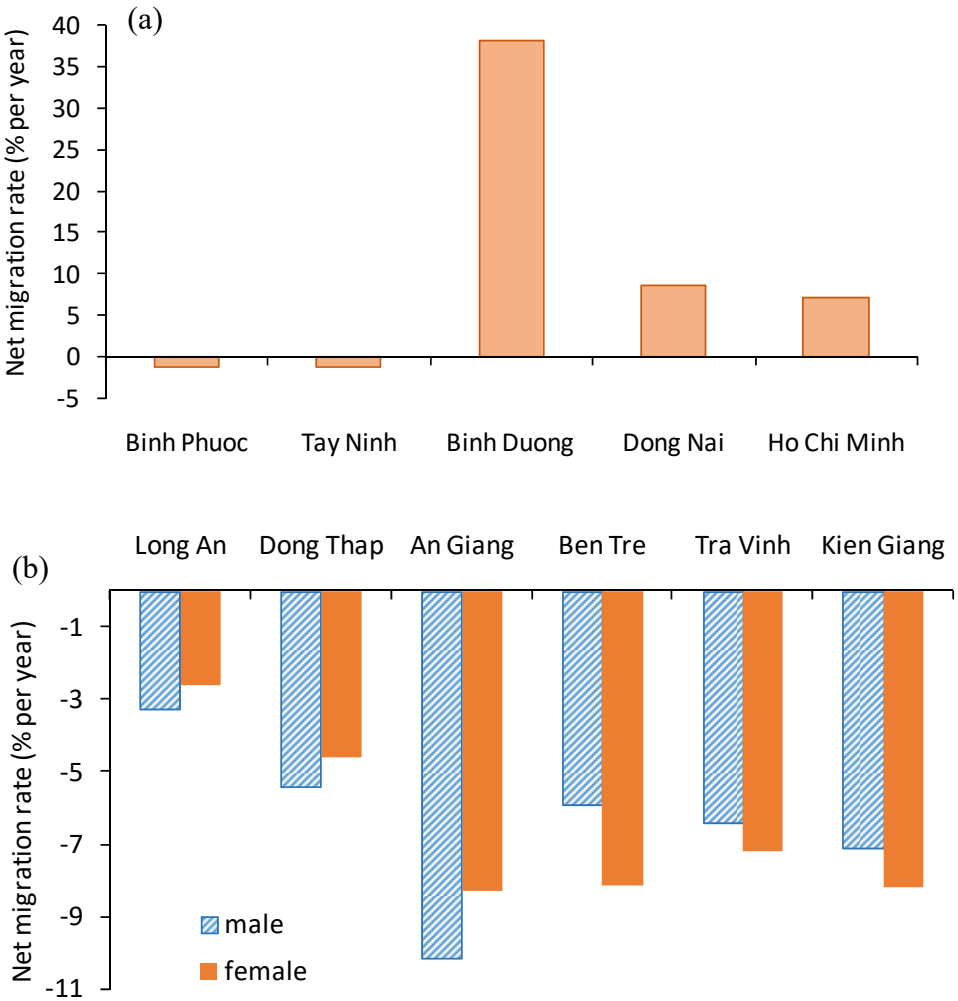


FIGURE 62: AVERAGE YEARLY NET MIGRATION RATES IN THE PERIOD 2014 – 2018 BY PROVINCE AND SEX: (A) THE SE PROVINCES AND (B) THE VMD PROVINCES (SOURCE: CALCULATIONS BASED ON GSO, 2016 – 2020)

Future expected situtations of the main indicators without interventions and hence expected impacts on groundwater and interventuion issues are identified in Table 42. Since 2018, the Viet Nam Government has implemented new Laws and issued many policy changes on spatial and sectoral integrated plannings, sustainable development to adapt to climate change and sea level rise, which are closely linked to land and water resource uses and livelihoods in the VMD[3].

Forest and agricultural land covers

Land covers of natural forest and agricultural land are expected gradually declining from shifting to urban and/or industrial land, and transporation infrastructure development. Presently forest land covers are significant in only Binh Phuoc and Tay Ninh provinces while in other industrial provinces (i.e. Dong Nai, Binh Duong and Ho Chi Minh), the forest covers are relatively low and have significantly dropped. Agricultural land covers of the later provinces graually declined in the last decade. The same situation occured in the VMD. Consequently, groundwater recharge is expected to decrease while water demands for domestic uses and economic development would increase in head-water areas like in the SE region and the upper VMD. Sustainable management of forest lands, surface water uses, rainwater capture and groundwater recharge management are important issues.

Agricultural production

Rice production areas and volume is expected to decrease in the VMD in the future. As planed by Viet Nam's Goverment, rice is shifted to the first to the third top agricultural commodity, after aquaculture, fruits and vegetables. Rice land area will drop about 300 000 ha and rice production volume will decrease by 6.3 million tons of paddy to 2030. Triple rice cropping will be shifted to double rice cropping, leading to larger flood plains in the upper- and mid-delta. This would result in an increase in flood water storage for later uses in downstreams and enhancing recharges in to aquifers during monsoon flood periods. Flood-based rice cropping systems, rooms for rivers, cooperative farming and using surface water resources are important concerns.

TABLE 42: FUTURE EXPECTED SITUATIONS OF MAJOR INDICATORS AND POTENTIAL IMPACTS ON GROUND WATER WITHOUT INTERVENTIONS

No	Indicators	Future expected situations	Expected impacts on groundwater	Intervention issues
	Land covers			
1	Natural forest land cover	- Gradually shrink from economic development and ecosystem changes	Reduced groundwater recharges	Sustainable management of natural and planted forests
2	Agricultural land cover	- Small reduction from urban and industrial development	Increasing demands and exploitation of groundwater	Surface water use, rainwater capture and groundwater recharge
	Agricultural production			
3	Rice production	- Reduced grown area and production - Increased open-flood plains	Increased flood water storage for downstream uses and	Flood-based rice cropping systems, rooms for rivers, cooperative farming and surface water uses

[3] Government Resolution 120 /NQ-CP on Sustainable and Climate-Resilient Development of the Mekong Delta of Viet Nam dated 17 November 2017; Decision No. 324 / QD-TTg on Approval on the Master Plan on Sustainable Development of Agriculture to Adapt to Climate Change to 2030 and in vision to 2045 dated 2 March 2020; Regional Mekong Delta Integrated Plan for 2020 – 2030 and in the vision to 2050 is being undertaking under the coordination of the Ministry of Planning and Investment.

No	Indicators	Future expected situations	Expected impacts on groundwater	Intervention issues
			enhanced recharges into aquifers	
4	Upland crops	-Increased areas in the SE region and the lower delta	Increasing demands and exploitation of groundwater	Sustainable farming practices, efficient use of irrigation water
5	Aquaculture	-Increased area and intensification of coastal shrimp farming	Increasing demands and exploitation of groundwater	Good farming practices, cooperative farming and enforcement of groundwater management
6	Livestock production	-Developed cattle production in the VMD	Small impacts on groundwater resource	Sustainable integrated livestock – crop farming systems, rainwater capture
	Livelihoods			
7	Poverty	-Increased head-counts of poverty from applying new income-level indicator from 2020	Increasing demand for groundwater resource	Poverty reduction in the lower delta, surface water supply and rainwater capture
8	Clean water use and food consumption	Better access to clean water supply systems and more diverse food consumption	Increasing demands and exploitation of groundwater	-Medium- and large-scale water supply systems, and rainwater capture -Good agricultural practices and food safety
9	Labour force capacity	Improved work skills	Possitive impacts on groundwater resource	Capacity for agricultural labour, women worker and labour in the lower delta
10	Labour income and migration	-Larger gaps between the SE and VMD regions, between agricultural and non-agricltural sectors -Increased rural migration to cities and industrial areas	Increasing demands and exploitation of groundwater in cities and industrial areas	Value and income from agricultural sectors, labour force capacity, rainwater capture and groundwater recharge
11	Male and female gaps	Narrow gaps between male and female from skilled young labour force	Higher income and better use of water resources	Vocational and water-use training for women, particularly in rural and agricultural sector
12	Participation of stakeholders	More effective coordination and	Possitive impacts on groundwater resource	Effective implementation of integrated plannings at regional and local levels

No	Indicators	Future expected situations	Expected impacts on groundwater	Intervention issues
		collaboration among stakeholders		

Upland crop production is expected to grow in the future. Fruit and industrial crops will be the major enterprises in the SE while perennial fruit and annual upland crops will be important in the VMD. The upland crop production area is planned to increase by 150 000 ha to 2030 being converted from rice and mixed orchards with low income[4]. According to the plan issued by Viet Nam's Government, fruits and vegetables are the second important agricultural commodity after aquaculture. Development upland crop production leads to increasing demands for groundwater extraction for irrigation in the dry season, particularly in the SE region and the lower delta. Large-scale or cooperative farming practices would improve crop water productivity. Sustainable farming practices and efficient use of crop irrigation water need to be pay attention. In reality, a large proportion of farmers did not use improved water-saving techniques even though they believed a causal relation between groundwater extraction and the drop of groundwater levels (Hamer et al., 2019). High input investments, poor access to information and economical trade-off in short-term are main constrains (Hoang et al., 2018; Hamer et al., 2019).

Aquaculture is secondary in the SE region while is considered the first important commodity of agricultural sector in the VMD to 2030. Coastal aquaculture is expected to extend and to be further intensive. According to the plan of the Government, coastal aquaculture area will grow up to 300 000 ha till 2030. Under pressures of water salinization and farming shifts to shrimp culture, demands for freshwater in the dry season and salt water in the wet season for saline and/or brackish aquaculture will increase, which would lead to increasing extraction of groundwater at different aquifer layers, without effective interventions. Officially, groundwater use for agricultural purpose with capacity > 10 m^3 per day and from the depth below 30 m needs to be applied for permission by local authorities (Decree 167/2018/NĐ-CP). However, drilling and extracting water from deep aquifers for agricultural uses by small farmers cannot be well managed. This is because livelihoods of farmers totally depend on agricultural activities and they have not any alternative water resources. Cooperative farming practices will allow more efficient and effective management of irrigation and effluent waters. Therefore, good farming practices and effective enforcement of groundwater management regulations are of importance.

Livestock production will not much change in the SE region while cattle production will grow in the VMD from the promotion to farming system shifts by the government. Cattle farming is integrated with grass culture and/or integrated with other crops, taking use of crop residues. Small-scale development of livestock production in general and cattle production in particularly would not significantly impact groundwater resource, compared to other economic sectors. Minimizing impacts of livestock production on groundwater resource can be achieved by sustainable integrated farming systems, which allows to efficient use of crop residues as feed and to decreasing irrigation water to feed production, and by rainwater capture.

Livelihoods

Poverty

Poverty rates in the SE and the VMD will increase in 2021, compared to 2020. Viet Nam 's Government will apply the new national multidimensional poverty line for 2021 – 2025, serving as the basis for making policies, mechanisms and solutions to achieve multidimensional, inclusive and sustainable poverty reduction. Achieving

[4] Decision No. 324 / QD-TTg on Approval on the Master Plan on Sustainable Development of Agriculture to Adapt to Climate Change to 2030 and in vision to 2045 dated 2 March 2020

sustainable poverty reduction, the demand of clean water supply for domestic uses will be higher, particularly in rural areas. Groundwater will be the main water source as surface water quality remains poor. The priority will be given to the lower delta, where current poverty rates are relatively higher and surface freshwater resource will become scarcer, and rainwater capture for uses.

Clean water access and food consumption

Sustainable poverty reduction and New Rural Development are considered the National Target Programmes of Viet Nam's Government. Accordingly, access to communal clean water supply by rural households will become better. This led to increasing demands of groundwater quantity and quality for domestic uses and income-generation activities if surface water resource uses will not be improved. In addition, food diet will be more diverse and food quality will increase, reducing dependence on starchy staples and increasing consumption of animal-derived foods, which would result in increasing use of groundwater as a "safe" water resource. Development of medium- and large-scale water supply systems, rainwater capture, good farming practices with less water use and food safety are important issues.

Labor force capacity

Given the National Target Programmes of the Viet Nam Government as aforementioned, labor work skills will improve through vocational and higher-education trainings given by public and private sectors. At the same time, the labor force will continue to shift from agricultural to non-agricultural sectors. Improved work skills and agricultural labor shift will allow more efficient use of water resources. Capacity of agricultural labor, particularly for women labor and in the lower delta, needs to be given a priority.

Labor income and rural migration

Labor income gaps and rural migration is expected to continue. Income gaps will be larger between the SE region and the VMD, and between agricultural and non-agricultural sectors. Low opportunities for jobs and low income from agricultural activities will lead to rural migration of labor force to cities and industrial zones, such as Ho Chi Minh city, Dong Nai and Binh Duong provinces. Consequently, demands for domestic water uses will increase there and groundwater is considered the main source. Future major concerns are value chains and income from agricultural sector, labor force capacity, especially agricultural labor and in the lower delta, rainwater capture and groundwater recharge in urban and industrial areas.

Gender gaps

Gender gaps are expected to decline due to capacity building of young labor force, better access to information and the National Target Programmes. Enhanced capacity of women allows contributes to the improvement of their income, social network and water uses. Education, vocational trainings, and knowledge of water uses for women and girls are important issues. Resource-poor and female-headed households need to be paid higher priority.

Participation of stakeholders

Vertical and horizontal coordination, and participation of stakeholder in natural resources management, particularly groundwater management will be more effective. This results from the implementation of regional and provincial integrated plans, where sectoral and spatial governance is addressed. Sustainable management of groundwater resource is one of key issues in the Revolution, Decision and integrated plan of the VMD by the government[5]. Doing so, there will be positive impacts on groundwater resource. Integration of future interventions of groundwater management with implementation of regional and provincial integrated plans is needed.

[5] Government Resolution 120 /NQ-CP on Sustainable and Climate-Resilient Development of the Mekong Delta of Viet Nam dated 17 November 2017; Decision No. 324 / QD-TTg on Approval on the Master Plan on Sustainable Development of Agriculture to Adapt to Climate Change to 2030 and in vision to 2045 dated 2 March 2020; Regional Mekong Delta Integrated Plan for 2020 – 2030 and in the vision to 2050 is being undertaking under the coordination of the Ministry of Planning and Investment.

SUMMARY

Synthesis of findings

The study investigates land uses and livelihoods in the SE region and the Mekong Delta of Viet Nam, where is considered relevant to Mekong groundwater resource. The study describes current situations, past trends and expected future of three groups of main indicators relevant to groundwater uses: (1) agricultural and forest land covers, (2) agricultural production, (3) livelihoods. In addition, drivers of changes and relevant stakeholders are also analyzed.

Agricultural and forest land covers

The SE region is relatively dominant with forest land while the VMD's land is largely devoted to agricultural production. Agricultural and forest land covers gradually shrank from urbanization and economic development, particularly with large cities and industry-dominated provinces. Efficient uses of surface water and effective management of groundwater recharge are of importance.

Agricultural production

Lowland rice production is an important agricultural sector in the VMD while a secondary one in the SE region. Intensive rice production with three rice crops a year has developed for four decades in flood plains - prone areas in the VMD. This resulted in decreasing open-flood areas, constraining water recharge into aquifers in the wet season.

Upland crop production in rain-fed areas of the SE region and the lower delta totally depends on groundwater in the dry season. Perennial fruits and industrial crops are relatively dominant in the SE region while perennial fruits and annual upland crops are commonly practiced in the VMD. Gradually growth of annual upland crops has occurred in the last decade, particularly in the lower delta, leading to increasing demands for crop irrigation water extracted from aquifers.

Aquaculture sector is minor in the SE region while it is realized important in the VMD. Aquaculture production has expanded and intensified. Development of coastal aquaculture production, under the context of droughts and salinity intrusion, threatens the degradation of groundwater resources in the VMD, without appropriate interventions.

Livestock production is an important sector in the SE region while it is secondary in the VMD. Livestock production grew unstably due to disease outbreaks. Cattle production has grown in the VMD in recent years under farming shifts to adapt to frequent droughts and salinity intrusion. Small-scale livestock production has relatively low negative impacts on groundwater resource, compared to other agricultural enterprises.

Livelihoods

The poverty rate is higher in the VMD, particularly the lower delta, than in the SE region. Poverty rates annually dropped in both regions and the dropping rate was lower in the VMD.

Rural resource-poor households have poorly accessed to clean water for domestic uses, particularly in the mid- and lower delta. Domestic water uses still higly depended on groundwater in the SE region and the VMD. Surface water pollution and salinity intrusion has constrained domestic supply and put higher pressure on groundwater exploitation in the VMD. Groundwater quality do not meet Viet Nam's and WHO standards for domestics uses in most cases in the VMD. Switching private wells to communal supply systems is of great importance in the future.

The SE and the VMD produced surplus food for domestic consumption at regional level. Food consumption of households has changed, consuming less starchy staples, vegetables and fruits, while more animal-derived foods. For food security at household level, resource-poor household still faced food utilitisation constraints.

The employment rates were lower in both regions than the the country average, and were higher with male than femaleurers. Skilled labour rates were lower with female that with male, and lower in the VMD, especially in the lower delta, than in the SE region. Unskilled labour commonly occures with agricultural sector.

Average income of labourer was low in the VMD and with female, compred to the SE region and male, respectively. Relatively low income of female labourer occurs with most of occupations. Relatively low income of labourers in the VMD is due to a large contribution from agricultural sector. Low income is one of barriers to accessing to communal water supply systems.

Population growth and urbanization rates were higher with the SE region than the VMD. Rural labor force in the VMD has tended to migrate to urban and/or industrial areas, mostly in the SE region for job opportunities. High out-migration rates took place in the lower delta.

Women are direcly and indirectly associated with groundwater uses and their health impacts. Women are recognised to poorly access to technical knowledge and work skills as well as related services. Women are responsible for many unpaid works that prevent them from getting formal and informal supports from the community for empowerment.

About a fifth of all rural households are headed by women, usually with the Khmer, in the VMD. Female-headed households are found more vulnerable to problems than male-headed ones. The proportion of resource-poor households is relatively larger with female-headed.

The participation of women in govermental and social organisations increased but a gender unequality still remains. The participation in decision making and empowerment among women group are constrained by cultural and social factors.

Drivers and factors of changes

Main drivers and/or factors of changes in agricultural and livelihood situations are identified in below. Most of changes in agricultural production and livelihoods, directly and indirectly, have negatively impacted groundwater resource through increasing water exploitation and/or reducing potential recharge into aquifers:

Global- and basin-scale drivers: Extreme weather, sea level rise and abnormal alterations of Mekong flows and sediments;

National-scale drivers: Policies on national food security and flood control, National Programmes on agricultural and rural development and regional plans for sustainable development of the VMD;

Regional-scale drivers and factors: Urbanization and industrilisatialisation, agro-business development, rural labor and capacity, and rural migration.

Relevant stakeholders

Local stakeholders relevant to groundwater resource management include governmental organizations and program offices, mass organizations, research institutions and NGOs (international, national and local level, including private sector and cooperatives.

Horizontal coordination among stakeholders and integration of management interventions at all levels are of importance. Agricultural production and water use are mostly in individually small-scale, constraining efficacy of water.

Expected future situation without interventions

Forest land, natural wetland and agricultural land covers are expected to decline, due to ecosystem changes and economic development. This will result in decreasing groundwater recharge while increasing water use demands.

Rice production will reduce as plans of the government, which allows restoring open-flood plains in the VND. In contrast, upland crops, livestock production and aquaculture will further develop, both extensively and intensively, increasing irrigation water demand in the dry season.

Low opportunities for employments in rural areas and larger income gap between agricultural and non-agricultural sectors will facilitate rural migration of labor force from the VMD to the SE region.

The National Target Programmes on sustainable poverty reduction and New Rural Development by the Government will support rural communities' better access to clean water supply, which leads to increasing extraction of groundwater resource if surface water will not be efficiently used.

Capacity building of young labor force and better access to information will allow narrowing gender gaps. Negative impacts of using poor water quality will decrease.

Coordination and participation of stakeholder within and between administrative-boundaries on water resources management and livelihood development will be more effective, resulting from the implementation of regional and provincial integrated plans, policy and institutional reforms by the Government.

Gaps for interventions

Future intervention issues by main indicator are described in Table 9. The following are the synthesis of gaps for the interventions:

- Balanced supply and demand of groundwater are not fully understood. The balance needs to be investigated at certain locations, ecological zones and regions by season under different uncertainties and scenarios.
- Groundwater value, both potential and real uses, are still unknown. The information is necessary for planning sustainable development, both water resource management and socio-economic development.
- Economical trade-offs between short and long run of current and alternative practices of groundwater uses need to be investigated. Alternative practices include good farming practices with high crop water productivity at household and community scale, rainwater capture and water desalinization for uses at household and community level.
- Long-term effects of groundwater use for domestic purpose and crop irrigation are not been fully known. In addition, effects of human capacity building, particularly women, on water uses need to be monitored and evaluated.
- Participation of private sectors in clean water supply at community level is of great importance. This contributes to reduced use of individual tube-wells of households in rural areas. Incentive mechanisms for such participations are necessary.
- Solutions for effective participation and coordination between relevant stakeholders within one and between different administrative boundaries on better management of both surface and groundwater resources are greatly important.

Annex N1: Gender and ethnic minorities analysis

Viet Nam

Gender and agricultural land and water uses

Viet Nam recognizes gender equalty as key component for sustainable agricultural development, including land and water management, responding to its obligations towards Gender Equality through the ratification of a range of international conventions and national commitments. Figure 63 shows the importance of the integrating a gender perspective in agricultural land and groundwater use. Over the past few decades, Viet Nam has made significant progress in promoting gender equality in all sectors by endorsement or revision of legal frameworks and policies on gender equality and the advancement of women, most notably the Gender Equality Law and the National Strategy for Gender Equality. Although sound achievements have been made thus far, there still exist gender gaps in agriculture, as eg. in the water sector, such as (i) poor sanitation, water borne diseases, health problems; (ii) less participation in decision making and capacity building/training; and (iii) poor economic conditions and low income as reflected in Figure 63: three major gender and water related issues in Viet Nam generally and for the Mekong Delta particularly.

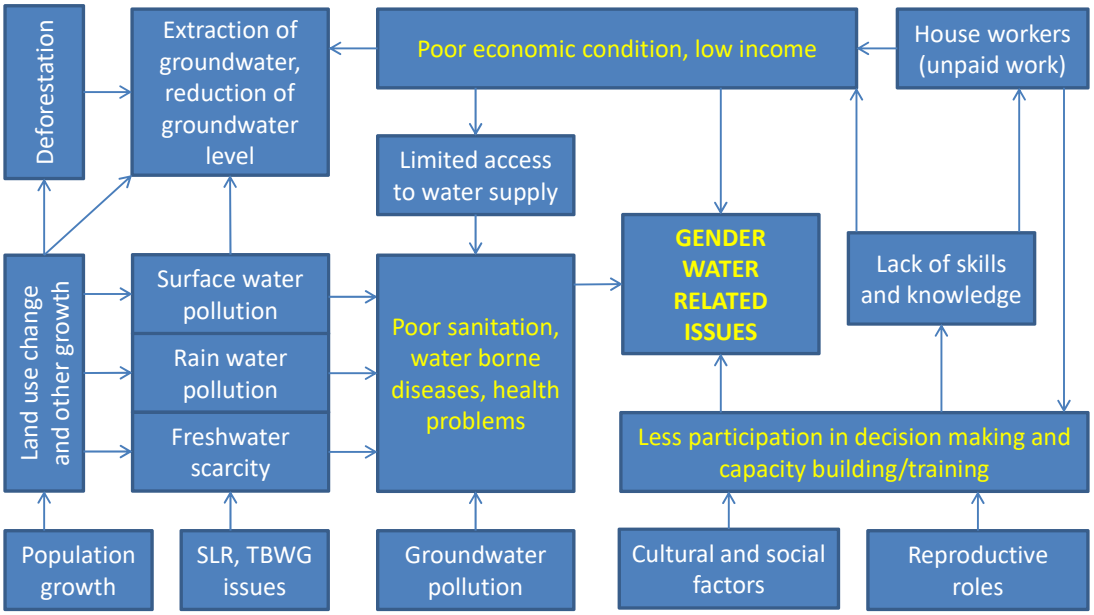


FIGURE 63: AGRICULTURAL AND WATER USES AND GENDER RELATIONSHIPS IN THE MEKONG DELTA (NOTE: SLR = SEA LEVEL RISE, TBWG = TRANSBOUNDARY WATER GOVERNANCE) (SOURCE: CREATED BY AUTHORS)

Gender, sanitation and health

Women and girls are especially affected by inadequate sanitation because of gender related differences, reflected in cultural and social factors, but also because of physical sex-related differences, as the required hygine for reproductive health, and risk of sexual harrassment if sanitation infrastructure is poor or absent. During menstruation, pregnancy and postnatal stages, for example, the need for adequate sanitation becomes even more critical and Toilet-avoidance dehydration is a particular health threat. Women often bear cleaning responsibilities and in many cases also are responsible for the disposal of human waste. Inadequate drinking water, sanitation and hygiene pose critical health risks to all children, but have additional implications for the health, psychosocial well-being and mobility of women and girls. Economic growth often aligns with natural resource degradation, and can exacerbate gender inequalities by increasing the burden on women in the context

of sanitation and health. This seems particularly relevant for the context of groundwater in the Mekong Delta, as women might have to walk farer to fetch water, or might be disproportionally affected by food scarcity. In a case study in An Giang province, Thai and Guevara (2019) found that poor water quality poses health risks and increases women' workloads due to the time spent on fetching water, collecting firewood and reproductive tasks as water boiling. In terms of water quantity, lack of water and increasing water scarcity can increase the burden of women when collecting water from alternative sources.

Increasing polution and scarcity of freshwater water resources strongly affect health of vulnerable groups (i.e. women, children and the poor). Figure 64 shows changes for the use of different water resources for drinking in the Viet Nam's Mekong Delta between 2008 and 2018. Dealing with surface water pollution and scarcity, local people extract more groundwater via individual tube-wells, accessing to tap/communal supplied water or bottled water. The percentages of households using tap water and groundwater for drinking increased while those using rain and surface water decreased. Due to limited financial capacity, households often use surface water from canals/rivers for bathing and washing while piped water for cooking and drinking. Thus, domestic water supply services that provided piped water will be unsuccessful if women can not afford the water use and return to their old sources like canals (Thai and Guevara, 2019).

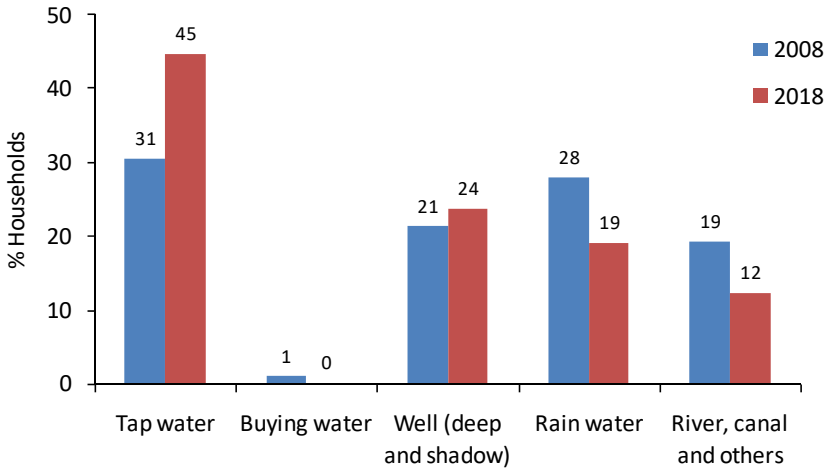


FIGURE 64: STRUCTURE OF HOUSEHOLDS BY MAIN SOURCES OF DRINKING WATER IN THE MEKONG DELTA (SOURCE: CREATED BY AUTHORS BASED ON GSO, 2019)

Gendered inequalities in capacity development, income generation, poverty and vulnerability status

According to the report of the Labor and Employment Survey in 2018 (in GSO, 2019), gender inequalities prevail for employment in many sectors across Viet Nam and in the specific case of the Mekong Dela. A large proportion of rural women do daily housework rely on water and other natural resources to fulfill reproductive activities as food provision or other domestic chores they are mainly responsible for (Truong Thi Ngoc Chi et al., 2019) (Figure 65). The proportion of unskilled labour is larger with female than male (Figure 66). Hence, more opportunities for education, trainings, job generation and labour skills for women are necessary.

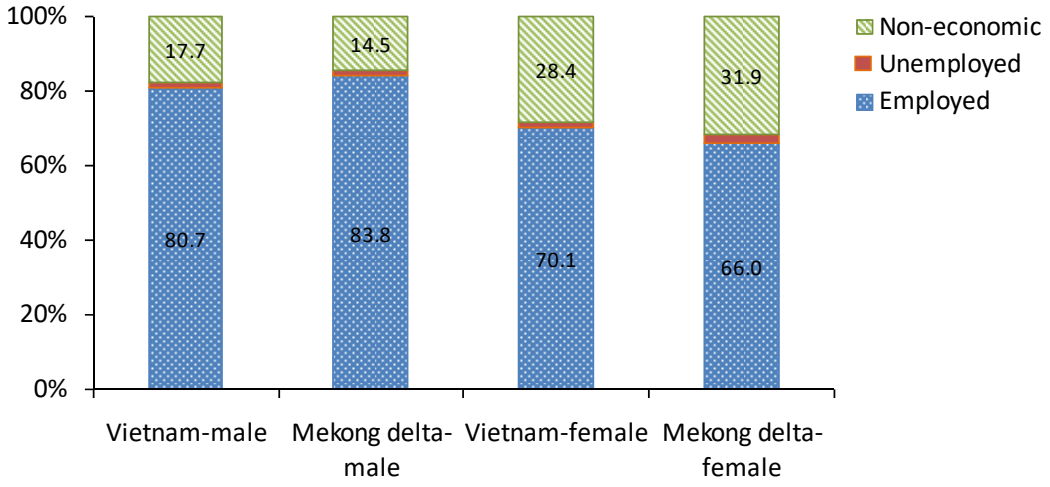


FIGURE 65: STRUCTURE OF POPULATION FROM 15 YEARS OLD AND ABOVE BY ECONOMIC ACTIVITIES IN 2018 (SOURCE: CREATED BY AUTHORS BASED ON GSO, 2019)

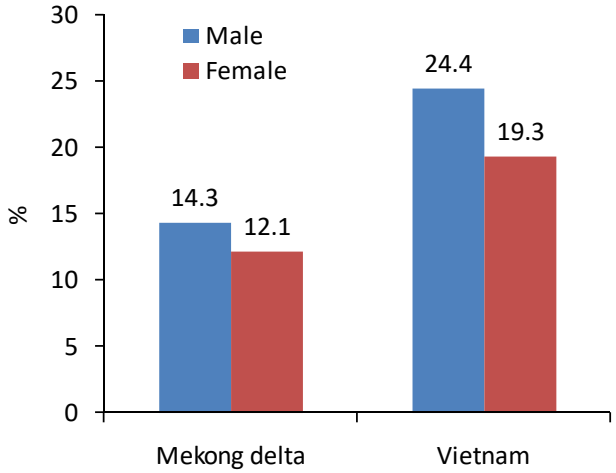


FIGURE 66: PROPORTIONS OF TRAINED PERSONS EMPLOYED IN THE ECONOMY BY SEX IN 2018 (SOURCE: CREATED BY AUTHORS BASED ON GSO, 2019)

Female labour earn lower income than male. Similar to the average situation of Viet Nam, average monthly work income of female labour in the Mekong Delta is nearly one million VND per person lower than male workers (Figure 67). Lower work income of female workers can be found across most occupations (Table 43). Considering that lower income is one of main barriers for accessing piped water supply systems, a water related disadvantage results for women (Danh and Khai, 2015).

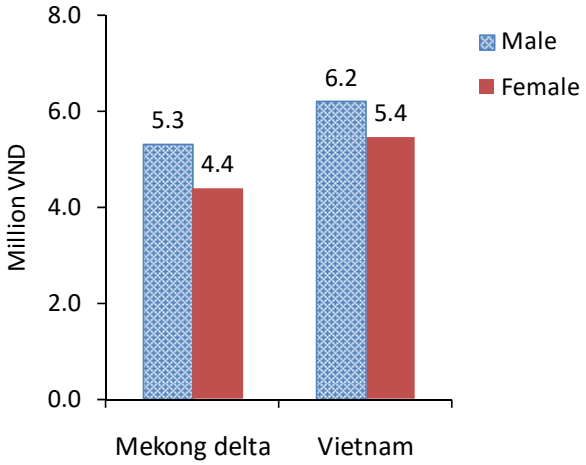


FIGURE 67: LABOUR INCOME BY SEX IN 2018 (MILLION VND PER PERSON PER MONTH) (SOURCE: CREATED BY AUTHORS BASED ON GSO, 2019)

TABLE 43: AVERAGE INCOME OF EMPLOYED POPULATION BY OCCUPATION AND BY SEX IN VIET NAM IN 2018

Occupational groups	Million VND per capita per month		
	Total	Male	Female
1. Leaders, managers	9.67	10.1	8.60
2. High-level experts	8.22	9.36	7.30
3. Mid-level experts	6.36	7.07	5.83
4. Office staff	5.70	5.71	5.69
5. Service and sale staff	5.01	5.34	4.59
6. Agriculture, aquaculture, forestry	4.91	5.13	4.31
7. Manual labors and related	5.44	5.68	4.74
8. Manual asembling and operating workers	6.25	6.82	5.71
9. Low-skilled labors	4.16	4.44	3.73
Average	*5.87*	*6.18*	*5.44*

NA = not available (Source: GSO, 2019)

In the lower provinces, more rural labour migrated to large cities and industrial zones, mostly to Ho Chi Minh City and the South-East region, to seek new job opportunities. Out-migration by sex differs between agro-ecological zones. In the lower provinces (i.e. Ben Tre, Tra Vinh and Kien Giang provinces), which are affected by salinity intrusion in the dry season and where shrimp-based farming is the main livelihood activity, more female labour migrated than male. The contrary occurs in the freshwater agro-ecological zone with farming diversity, including rice, fruit, vegetables, fish and livestock production (i.e. Long An, Dong Thap and An Giang provinces) (Figure 68).

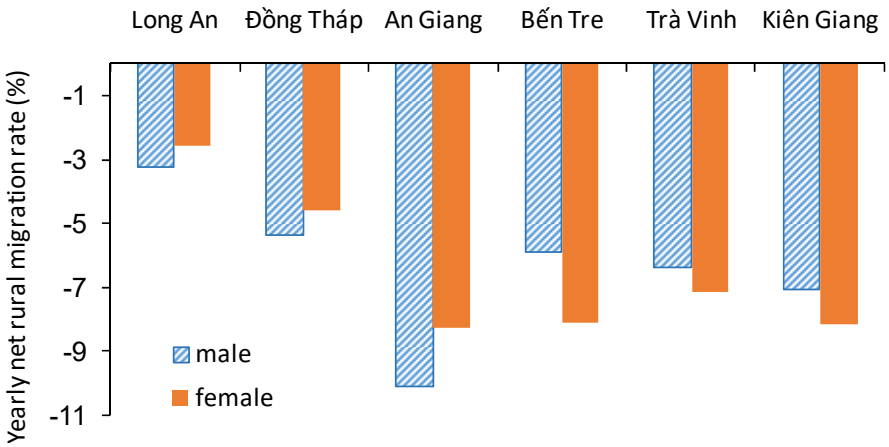


FIGURE 68: YEARLY NET OUT-MIGRATION RATE BY SEX AND PROVINCE (SOURCE: CREATED BY AUTHORS BASED ON GSO, 2014 – 2018)

About a fifth of all rural households in the Mekong Delta are headed by women (FAO, 2010). The proportion of female headship is usually higher with the Khmer. The significant inequality between male and female headed households in the agricultural sector includes farm size, access to agricultural information and commercial farm ownership (FAO, 2010). The proportion of households considered "poor" is larger with female headed households (Tran Cong Kha, 2018).

Female-headed households are more vulnerable to a range of factors: (1) internal socio-economic factors (weak infrastructure, uncertain markets, non-availability of credit; (2) external environmental vulnerability related to degradation of ecosystems (pollution, exhausted natural); and (3) natural change impacts (inundation, erosion, salinity intrusion) (Tran Thi Phung Ha and Nguyen Thanh Binh, 2014). Livelihood strategies can be grouped into three ways: (1) learning to live with change and uncertainty, (2) nurturing learning and adapting, and (3) creating opportunities for self-organization (Folke et al., 2003, cited in Marschke & Berkes, 2006). Women mostly choose ways 1 and 2, short and medium-term activities.

Gendered dimension of decision making and women's empowerment

Despite the key role women play in food security through their knowledge of crop production, local biodiversity, soils and local water resources, they are often excluded from decision-making processes in new agricultural water management systems and other projects and initiatives on natural resources allocation. Equal and meaningful participation of women in decision making and empowerment are constrained by underlying gender inequalities, as the lack of data and research on women's key contribution to water management; their lack of assets and skills, as they do have less access education and knowledge and are therefore less representation in decision-making positions.

Incorporating gender issues as women's triple work burden in reproductive, productive and social spheres and the high incidence of female-headed households in the region, as well as their higher vulnerability to crisis and Climate Change Impacts and gender-based violence and discrimination due to social norms, will enable to make informed choices during planning, design, and construction and operation of water management projects and programmes, which will make water management in agriculture more effective, efficient, equitable and sustainable Women tend to assume a triple work burden in agricultural settings: productive, social and reproductive tasks. (Fig. 5). Time allocation within 24 hours is a tool to assess the work burden of men and women. Using this tool, FAO's survey (2017) in Soc Trang with rice-rice and rice-shrimp farming systems

showed that women spent more time for household work than men, resulting in shorter time for their leisure activities, further education or scaling up of their technical skills and agricultural production (Figure 69).

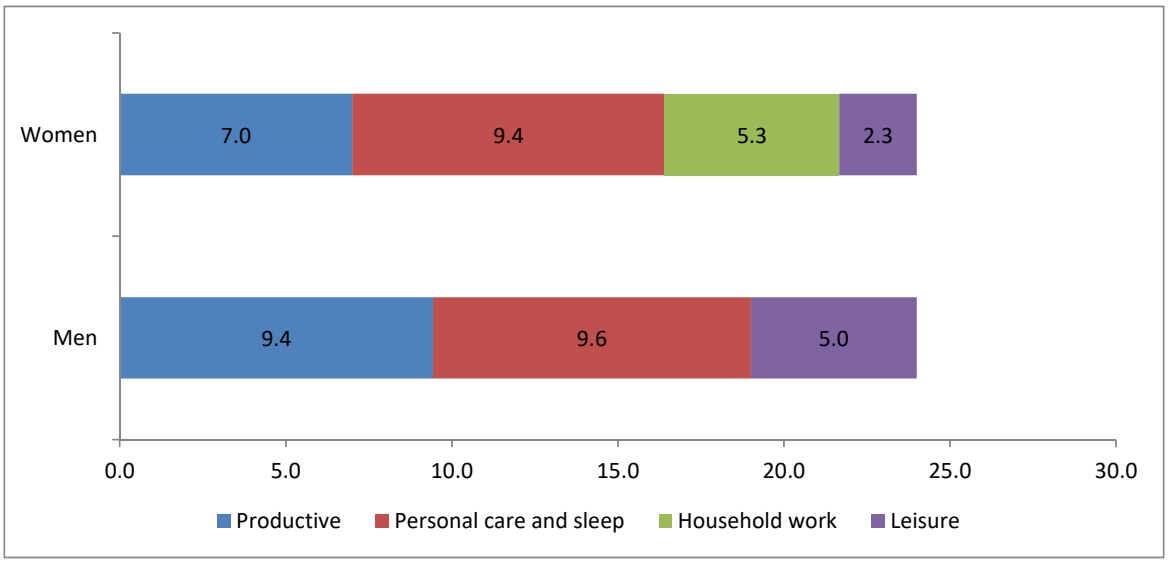


FIGURE 69: TIME ALLOCATION BETWEEN MEN AND WOMEN IN SOC TRANG PROVINCE (CREATED BY AUTHORS BASED ON FAO, 2017)

Work burden is a major obstacle for women as many of their tasks are not recognized as work (unpaid tasks) (FAO, 2017). In addition, due to male migration into cities, many heavy activities in rural areas fall back on women, including the spraying of pesticides. Therefore, it is necessary to recognize the role of women and to reduce their burden.

The participation of women in govermental and social organisations increased, but gender inequalities still remain.

The proportion of women participating in local People's Councils grew by 3-7 percent from 2004 to 2016, but counted for less than 30 percent (Table 44). Gender inequality also prevails in terms of leadership, see Figure 70. The proportions of women as members or leaders of local social organizations is lower than those of men as shown in Table 45.

TABLE 44: WOMEN IN PROVINCIAL, DISTRICT AND COMMUNE PEOPLE'S COUNCILS (%)

Administrative levels	2004-2011	2011-2016	2016-2021
Province	23.8	25.7	26.4
District	22.9	24.6	27.5
Commune	19.5	17.7	26.7

Source: (FAO, 2019, Country Gender Assessment Report)

At the household level, men are also the major decision makers for most farm related activities. In Soc Trang province, husbands consult with their wives on almost all production decisions but ultimately have more decision making power. Women make more decisions associated with consumption and marketing of farm products, as summarised in Table 46. For annual upland crops, however, women have a greater decision-making power.

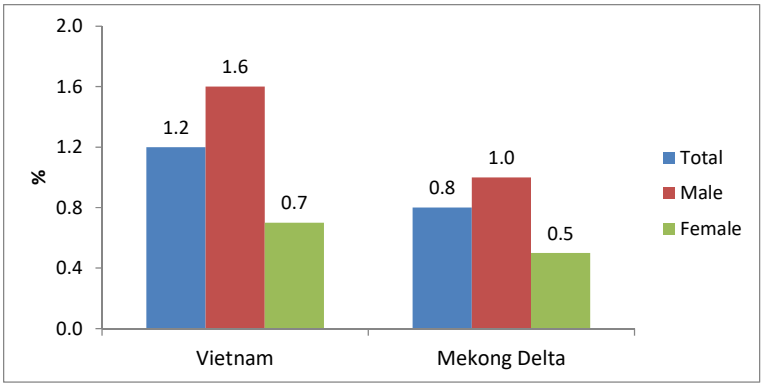


FIGURE 70: EMPLOYED POPULATION IN LEADERSHIP ROLE BY SEX IN 2018 (CREATED BY AUTHORS BASED ON GSO, 2019)

TABLE 45: PARTICIPATION IN SOCIO-POLITICAL ORGANIZATION IN VIET NAM BY GENDER (% RESPONDENTS OF 4.212 WOMEN AND 4212 MEN)

Organizations	All (%)	Men (%)	Women (%)
Youth Union	6.92	9.4	4.51
Women's Union	27.83	0	54.70
Veterans' Association	9.81	18.87	1.00
Farmers' Association	23.48	25.75	21.26
Labor Confederation	4.76	4.57	4.95
Fatherland Front	2.47	3.91	1.06
Communist party	8.34	11.78	4.98
Others	8.00	9.29	6.76

Source: ISDS (2015)

Women participated in farming practices but their access to technologies and related services are constrained. For example from Tra Vinh Agricultural Extension Centre, around 80 percent of 8 463 participants that attended 283 training classes in 2019 on farming technologies were men (unpublished data). The same status is reported for Bac Lieu province by Truong Thi Ngoc Chi et al. (2019).

Insufficient access of women to decision making processes as well as farming services constrains them in the application of new technologies and in voicing their needs and constraints. Women who lack decision making power have less opportunities to participate in water management. Although women are the main water users and managers of households, women are still afraid of speaking about water-related activities in the presense of men due to a restrictive culture (Thai and Guevara, 2019). Although women are globally recognised as the primary managers in water related activities, women' participation as well as their roles and responsibilities are still disregarded in the perspectives of policy makers and Viet Nam's society as a whole. Therefore, increasing level of women participation in community organizations is necessary.

TABLE 46: FARM RELATED DECISION MAKING IN HOA TU 1 COMMUNE, SOC TRANG PROVINCE

	Rice	Shrimp	Bean	Squash
What variety, crop or breed to use	M=W	M>W	W>M	W
Amount of seeds/shrimp larvae to use	M>W	M>W	W>M	W>M
Timing and amount of fertilizers or shrimp feed to use	M	M	M>W	W>M
Timing and amount of pesticides	M>W	M>W	M=W	W>M
Whether to use new technologies	M>W	M>W	M>W	M=W
To attend farm related meetings	M>W	M>W	M>W	W
Amount of farm products to keep for home consumption	M>W	M=W	W	W
At what price the commodity should be sold	M=W	M	W	W

M=Men, W=Women; Source: FAO (2017)

Gender considerations for improved water resource management

Gendered impacts of water depletion are not sufficiently reflected in research and data for evidence-based decision-making is lacking. Knowledge and skills of women in water resources use, particularly groundwater and water hygiene and sanitation, are not well investigated. Impacts of water pollution, access to and control over groundwater uses related to women and children health, need to be assessed for improved transbourdary water management. Mainstreaming gender issues into current policies and development plans (restructuring agriculture economy, rural development, climate-smart agriculture, adaptation to climate change and sea level rise) must be included in the aquifer coordination mechanisms, and therefore included in the baseline data gathered in the TDA, informing the coordination. The gender analysis will particularly focuss on access, control over and use of groundwater resources.

It is essential to determine what men and women in water resource management need, what they can and will contribute to, and how they will participate actively in decision-making on the types and levels of service, location of facilities, operation and maintenance. Gathering the needs and constraints of both men and women, and the impact of resource depletion on their livelihoods will lead to a better understanding of existing practices and challenges. It will help identify the aspects to be included in management strategies for coordination mechanisms to better investment decisions. Better solutions will be found to problems encountered in planning, design, operation and maintenance of groundwater management. Involving both women and men in decision-making with respect to water management will create a stronger feeling of ownership and improve their access to, and control over, water services through improved legislation. A more equal and efficient water distribution will also be possible, leading to higher yields, improved food security and the reduction of poverty.

Among others, women assume key roles in reproductive tasks like fetching water, collecting firewood, food provision for the family, care taking roles for children, elderly and sick, livestock production, upland crop irrigation, which are frequently relevant to groundwater uses. Gender empowerment, monitoring and impact evaluation are of importance in current development programs and projects, applying participatory approaches and needing participation of different stakeholders (Tran Thi Phung Ha and Nguyen Thanh Binh, 2014).

Internal and external gender inequalities resulting from migration as well as opportunities for income generation for women, particularly female-headed households in rural provinces need to be investigated for policy recommendations in current development programs.

This Gender and Ethnic Minorities Action Plan (GAEP) aims to ensure gender mainstreaming as one of the dimensions in formulated activities of the project ”Enhancing sustainability of the Transboundary Cambodia - Mekong River Delta Aquifer”. Gender and Ethnic minorities are integrated in a variety of sections of the main ProDoc including the Results Framework, stakeholder analysis, and risk analysis.

Vietnam’s Mekong Delta consists of 13 provinces and cities, with a population of more than 17 million people. Nearly 1.4 million people belong to ethnic minorities (accounting for 7.98 percent of ethnic minorities in the country), mainly Khmer, Chinese and Cham people. Ethnic minorities in the Mekong delta own fewer assets and earn less income than ethnic minorities in other regions. The poverty rate among Khmer minority households in Viet Nam’s Mekong delta is high with nearly 20 percent, compared to an average of 8 percent for the entire population. This emphasizes that the rich-poor disparity between ethnic groups is still very high.

Income of ethnic minorities is mainly based on crops and livestock although typically they own less productive land, which means that they are more dependent on swidden agriculture. Recently, the hunger for electricity leading to the loss of arable low land along the rivers and streams due to the construction of hydropower dams that make food security and livelihoods of ethnic minorities more challenging. It is often reported that ethnic minorities have less access to formal financial services, market access, road networks and public services. Ethnic minorities have also less off-farm employment opportunities.

The development of ethnic minorities in river basins must be considered in the way of creating sustainable livelihood practices for example agroforestry, processing of non-timber forest products, sustainable cultivation on sloping land to improve environmental protection and reduce the pressure on natural land and water resource. This situation of ethnic minorities in the Mekong delta must be considered during project design and execution.

Cambodia

In Cambodia, people of Khmer ethnicity account for 90 percent of the population, while the remaining 10 percent is composed of ethnic minorities such as Muslim Cham, Chinese, Vietnamese and 17 other indigenous ethnic minority groups who are ethnically non-Khmer. The 17 indigenous ethnic minority groups are estimated to comprise around 199 142 people or 1-2 percent of the total Cambodian population and fall into 20 indigenous minority groups. They mainly constitute the majority in the provinces of Ratanakiri (96 972), Mondulkiri (31 582), Kratie (40 944), Preah Vihear (16 760), Kampong Thom (13 044), Stung Treng (10 194), Udor Meanchey (3 622), Kompong Cham (2 564), Pursat (1 981), Kompong Speu (1 833), Battambang (563), Bonteay Meanchey (474), Sihanuk Ville (106), Siem Reap (244), Koh Kong (1 064), see Table 47.

TABLE 47: INDIGENOUS PEOPLE IN CAMBODIA

No.	Type of IP	Rathanakiri	Mondulkiri	Kratie	Preh Vihear	Kompong Thom	Steung Treng	Odor Meanchey	Kompong Cham	Pursat	Kompong Speu	Bontey Meanchey	Battambang	Sihanuk Ville	Siem Reap	Koh Kong	Total
1	Kouy			9 242	16 731	13 044	5 755	2 203				0	8		**244**		**47 233**
2	Phnorng	559	29 383	13 556	24		652	699					3				**44 876**
3	Tumpoun	35 644	343		5		15	281					16				**36 304**
4	Charay	22 879	119				12	158					14				**23 183**
5	Kreung	21 383	126				287	124									**21 911**
6	Steang		642	9 406				27	2 564								**12 639**
7	Prov	8 869					504										**9 373**
8	Kavet	3 983					2 710	18									**6 711**
9	Krourl		727	3 755				29									**4 511**
10	Mel			3 375													**3 375**
11	Kachork	3161					0	52									**3 213**
12	Por				0					1 207		563					**1 770**
13	Khonh			754									433				**1 187**
14	Chong									774						**1064**	**1 838**
15	Souy										1 833						**1 833**
16	Thmoun		242	856				0									**1 098**
17	Lun	492					268										**760**
18	Sa Och													106			**106**
19	Roder	2						16									**18**
20	Khe							15									**15**
21	Ro Ang																**0**
22	Spung																**0**
23	La-eun																**0**
24	Samre																**0**
Total		**96 972**	**31 582**	**40 944**	**16 760**	**13 044**	**10 194**	**3 622**	**2 564**	**1 981**	**1 883**	**563**	**474**	**106**	**244**	**10 64**	**221 953**

(Source: Cambodia Agricultural Sector Diversification Project (CASDP) - Indigenous Peoples Planning Framework (IPPF): Project Operations Manual and Ministry of Rural Development, 2018)

The indigenous ethnic minority groups in Cambodia are the most vulnerable in regards to their rights to access and utilize the land for traditional rice and crop plantation as well as right to access the NTFPs in the forest. The vulnerability is due to the rapid growth of social and economic land concession, hydropower dam development, large scale agro-industrial crop, and illegal logging and mining activities. These ethnic minorities have also very limited access to public services such as education, health as well as agricultural extension services and water supply system. Additional vulnerabilities arise from traditional and spiritual practices, such as old-style rice cultivation, crop plantation and livestock production, which have low yields. In terms of public consultation, they do not have full participation or full access to development activities (IFAD 2012: Technical Country Note on Indigenous People's Issues and Earth Right International, 2015). In important IP provinces such as Rattanakiri, indigenous ethnic minorities are among the most threatened due to the unfair or inappropriate development disruption caused by the expansion of large groundwater consuming coffee, rubber, or cashew plantations. Consequently, water access of indigenous communities for either household consumption or irrigation during the dry season is increasingly difficult despite high availability of water access (either surface or groundwater).

The loss of land rights and natural resources plus the very limited access to public services and agricultural value chain support have contributed to the loss of potential land access for agricultural production such as rice, crop and vegetables, loss of jobs, impoverished livelihoods and health, loss of opportunity to attend school, and loss of traditional and cultural practices (ICSO, 2017: Status of Indigenous People in Cambodia and World Bank's macroeconomic and fiscal model database in May 2018). The poverty of indigenous communities also relates to Indigenous Peoples' lack of representation in decision-making and in formulating and enforcing policies and laws.

The development and management of groundwater in the Mekong Delta Aquifer needs to consider socioeconomic and livelihood related conditions of indigenous communities. One approach is to help diversifying their livelihoods from traditional but unproductive rice cultivation, livestock production and crop plantation to be more environmentally friendly. This could be supported by water efficient and climate resilient technologies such as climate smart agriculture, drip irrigation systems, non-timber forest products collection and processing as well as diversifying into groundwater and surface water related tourism activities. Besides, the improvement of IP's representation in the social and public sphere's decision making would enable IP's interests and benefits are assured related to groundwater management and livelihood diversification.

Gender Inequalities in Cambodia

In regards to gender, consultations with national ministries such as Ministry of Environment (MoE), Ministry of Agriculture, Forestry and Fisheries (MAFF), Ministry of Rural Development (MRD), and Ministry of Women's Affairs (MoWA) as well as the provincial departments, have confirmed that there is no concrete data of the gender inequality and gender difference on groundwater management for household consumption and agricultural production. Further, there are no existing legal instruments, strategies and actions plan tapping the gender sensitive and responsive groundwater access and management. However, MRD is now encouraging the participation of women in management committee of community tube wells.

Focus group discussions during the PPG field missions also confirmed that women are mostly responsible for water collection for households and short-term vegetables cultivation while long term agriculture irrigation, for instance rice in Prey Veng and Svay Rieng and cashew in Kampong Cham, is done by the men. Poor families cannot afford to buy water filters or water purification tablets. Consultations with the Ministry of Women's Affairs (MoWA) and the Ministry of Rural Development (MRD) confirmed that obtaining water for domestic use in Cambodia is primarily women's responsibility, while men manage water for farming and economic

activities (TAF, 2019). Although women are mainly responsible for collecting groundwater for household consumption only 30 percent of management committee for tube wells in five visited provinces are women. Furthermore, although women are in charge of collecting groundwater for households and short-term vegetables cultivation, technologies (e.g. irrigation timers, comfortable water collection methods) that could reduce their burden are extremely limited. Exceptions are a few female farmers that benefited from targeted project work (e.g. climate smart agriculture project CHAIN in Preah Vihear, Odor Meanchey, Stung Treng and Kratie or the IFAD's ASPIRE program) where drip and sprinkler irrigation technology was introduced. In rural areas, access to clean and potable water for households is a real problem and it is income dependent, as women and girls of poor families spend at least 1 hour a day for collecting water for household consumption and 3 hours a day for irrigating the vegetables cultivation (TAF, 2019 and SNV, 2020). In times of water quantity or quality problems, households rely on women's knowledge to find water and properly treat it. In terms of decision making, women have very little voice in the management of surface or groundwater (tube wells and wells) as gender equality policy and strategy are absent for water management in MRD, MAFF, MoWRAM and MoWA.

Annex N2: Gender Integration and Equality Approach and Action Plan

Groundwater and gender are intrinsically linked. Women and men differ in their needs for and uses of groundwater, access to groundwater, level of participation in groundwater management, and willingness to participate in groundwater monitoring, among others. Globally, women play a pivotal role in groundwater management as they represent almost half of the workforce in agriculture and food production, and often bear the daily burden of fetching and carrying water from wells and boreholes to their families due to specific gender roles in society. In the project region, there is very limited representation of women in water governance institutions both at managerial and technical staff level. Inclusive and gender-responsive policies related to transboundary aquifer systems are missing.

To address these constraints, the Project will adopt the "Gender integration and Equality Approach for Transboundary Aquifers (TBA-GiEA)". The activities included in this approach will produce the knowledge base for the formulation of the Water and Gender Action Plans (GAP).

The TBA-GiEA has been specifically tailored to the project needs and aligned to the project intervention logic. It is also aligned with the GEF and FAO Policies on Gender Equality, the 2030 Agenda with particular focus on SDGs 5 intersecting other relevant SDGs, namely SDG 6, 13, 17 on partnership, including 17.18 related to the collection of disaggregated data.

The Gender Integration and Equality Approach has the overall goal of ensuring a balanced participation of women and ethnic minorities in project activities, and of fostering the empowerment of women in the Mekong Delta Transboundary Aquifer. It aims at providing a roadmap for full integration of gender considerations into the project Vision and its implementation. Its approach to gender integration and mainstreaming is two pronged: i) consideration of the roles, needs, concerns and interests of both women and men in all project activities, and ii) design and implementation of specific activities explicitly aimed to empower women and include ethnic minorities.

The approach will:

- Address systemic constraints on rural women and ethnic minorities in the Transboundary Cambodia-Mekong River Delta aquifer project areas;
- Strengthen capacity on gender integration and gender analysis;
- Include disaggregated data by gender, age and ethnicity when appropriate;
- Include activities that ensure women can meaningfully participate in, contribute to, and benefit from the project;
- Engage men as stakeholders and partners in gender equality efforts;
- Integrate a gender-responsive approach in both the institutional and technical levels of the project.

Implementation approach and project activities

In line with the approved PIF and the GEF Gender policies and guidelines, the TBA-GiEA will concentrate on the following priority action items:

1. **Gender, water and livelihoods analyses** in both country segments of the TBA, to have an overall understanding of gender roles and relations, gender differentiated access to and control of water resources, in particular groundwater and gender-differentiated livelihood strategies.
2. **Coordination, knowledge management and communication** for gender equality and women's empowerment, including the creation of a system of Gender Focal points at national and aquifer levels
3. Capacity development on gender integration in TBA governance
4. **Gender integration support to all project activities** to achieve an overall gender-responsive project approach

5. Developing the Groundwater Gender Action Plans (GAP)
6. Monitoring and evaluation

The TBA- GiEA will be implemented by a "Water and Gender Integration Team" composed by international and national Water and Gender specialists, and designated national staff members from the project executing Ministries from Cambodia and Vietnam. The UNESCO WWAP Water and Gender Unit will provide overall technical support.

Action item 1 (A1): Gender, water and livelihoods analyses

Gender, water and livelihoods analyses will be conducted in both project countries to have an overall understanding of gender roles and relations, gender differentiated access to and control of water resources, in particular groundwater, and gender-differentiated livelihood strategies. Considerations to ethnic minories will be included.

Activities proposed:

- **An in-depth gender, water and livelihoods assessment** is proposed for first quarter of the project implementation, in order to complement the already conducted baseline gender analysis. This study will include a focus on ethnic minorities. The study findings will inform the TDA, allow the establishment of a well-informed project gender baseline (**Output 1.3**), and enable the design of, and agreement on the **Project Gender Action Plan (GAP)** within the context of the TDA-SAP process.
- **A diagnostic study of gender-responsiveness of water policy frameworks in both countries.** This study will assess the scope and nature of policies in place for ensuring the achievement of gender equality, as well as the status of implementation to inform the TDA **(Output 1.3).**
- Gender impact analysis of innovative groundwater management and utilization pilot demonstrations conducted for each of the pilot demonstrations proposed for the Project (**Output 2.1**).

The implementation of these studies will follow the guidelines and methodology developed by UNESCO WWAP, which includes the collection of quantitative and qualitative data disaggregated by gender, age, and ethnic background. Study tools will include background document review, surveys, in-depth interviews with key informants and focus group discussions as appropriate.

Action item (A2): Coordination, knowledge management and communication for gender equality and women's empowerment, including the creation of a system of Gender Focal points at national and regional levels **(Outcome 5.1).**

The TBA-GIEA assumes that ensuring **equitable representation of all members of the communities** linked to the project in both countries is a prerequisite for the sustainability of the project interventions. One of its main priorities is to make certain that the opinion, needs, concerns and preferences of women and minority groups are represented in the planning and implementation of the project. Therefore, to ensure the inclusion of women at all stages of stakeholders' consultation processes the following actions will be undertaken:

- Establishing an Assessment Team with equal participation from women and men officials from relevant ministries and institutions for advising and monitoring progress on gender and minority issues (**Outcome 1.1**); this Assessment Team will also take part of stakeholder consultations, events and dissemination actions**.** The Team will include national **Gender Focal Points (GFP)** that will help link the project executors with the communities of water users (**Output 5.1**).
- Collaborating with local women NGOs and women projects on WASH, economic empowerment, agriculture and fisheries, which will help access local knowledge and know-how to reach women who otherwise might not be accessible to international projects (**Output 5.4**).
- Coordinating with other ongoing initiatives (**Output 5.4**): several national and international stakeholders are implementing NRM, water and agricultural activities that can be complementary to the TBA-GiEA

scope of gender equality and women's empowerment. It is therefore important to coordinate with these other projects to avoid duplications and promote effective support.

- Within IWLearn, create a "**TBA Gender and Ethnicity" on-line resource library** to make available key resources developed by the project related to gender integration in transboundary groundwater governance (**Output 5.5**).

Action item (A3): Capacity development on gender integration in TBA governance

Gender integration efforts within project activities will not be fully effective unless gender is mainstreamed and integrated at the institutional levels. With this in mind, the TBA-GiEA approach includes a range of capacity development activities on gender awareness and integration decision-makers and key stakeholders, including JTC, TCCB and IMCs.

The project will develop a Plan on structured capacity development activities in groundwater governance for decision makers and other stakeholders (**Output 5.1**). The plan will be agreed with beneficiary countries and be based on the following activities:

- Enhancing the capacity of the JTC, TCCB and IMCs to promote gender-responsive approaches and gender integration in all project activities (as per Outcome 1.1)
- Capacity development of national and regional Gender Focal Points on how to identify gender-related priorities in groundwater management and groundwater dependent livelihoods and integrate gender-responsive perspectives into their areas of work.
- Capacity development activities focussed on the integration of gender-responsive approaches into conjunctive surface and groundwater management, both at project and the country levels, including gender mainstreaming in water policies.
- Building capacity to enable women's participation in irrigation users' organisations -both as members and as leaders-, given the preponderance of irrigation as the main use of groundwater in the project. Attention to ethnic minority inclusion will be ensured.
- Developing a gender and ethnicity knowledge needs assessment useful for adjusting the content of the capacity development Plan.
- Training and mentorship of the participating ministerial staff, water and land administrators and decision-makers on water and gender indicators for transboundary groundwater governance and policies. This will be done through the implementation of modular training courses developed by UNESCO WWAP and adapted to the specific context of the Mekong project. Examples of WWAP training topics include:
    - Understanding water and gender to achieve the 2030 Agenda
    - Sex and age disaggregated water data: why are they crucial in aquifer management?
    - Gender-responsive groundwater assessment, monitoring and reporting
    - From theory to practice: how to develop a groundwater and gender survey
    - Linking data to comparable information: the use of groundwater and gender indicators
    - From sex-disaggregated water data to evidence-based policies
    - From policy to action: gender-transformative water policies and programming

In addition, "Guidelines on Gender and Ethinicity Integration into Transboundary Aquifer (TBA) Management" will be developed during the project and translated into the Cambodia and Vietnam national languages (Output 5.1). The guidelines will include user-friendly tools and techniques to assist project staff and partners in topics such as: (i) design of gender-responsive policies for transboundary groundwater governance; (ii) use of dedicated water and gender indicators for transboundary groundwater governance, and (iii) strategies for a

balanced and equitable participation of women, ethnic minorities and vulnerable groups.

Action item 4 (A4): Gender integration and support to Components' activities to promote an overall gender-responsive project approach **(Outcome 4)**

To ensure that a gender equality approach is integrated across all project cycle, the Assessment Team will review all project documents including the **SAP** (**Output 4.3**). Among others, the following aspects will be monitored: gender mainstreaming, inclusive language, a balance gender participation and equal share of project benefits. Other activities will aim at:

- ensuring gender balance in technical trainings on groundwater assessments (**Output 1.1; 1.2**) and monitoring system operations (**Output 3.1**) through inclusive appointments, making purposive efforts to hire women in scientific and technical positions.
- ensuring a balanced representation (in terms of gender and ehtinc minorties) and a participatory approach to the development of the long-term Vision (horizon 20 years) of the project (**Output 4.2**).
- promoting gender balance at national and regional events, public participation and consultation events, regional seminars and workshops, capacity building and training events, etc. and fostering the participation of women´s organizations when pertinent.

Action item 5 (A5): Developing the Water and Gender Action Plans (GAP)

Based on the findings of the gender, water and livelihood assessments (**Output 1.3**), the gender and ethnicity knowledge needs assessment (**Output 5.1**), and informed by the overall project implementation feedback, a Water and Gender Action Plan (GAP) for the Cambodia- Mekong Delta Transboundary Aquifer will be developed (**Output 4.3**).

The GAP will identify and propose key transformative actions to improve gender equality, women's empowerment and participation, together with ethnic minorities, in the management and governance of the Mekong Delta Transboundary Aquifer. It will inform and contribute to the preparation of the SAP.

The draft GAP will be discussed in stakeholder participatory consultations including local women organizations from agriculture and fisheries from both Cambodia and Vietnam (**Output 5.3**) to make sure it appropriately responds to the needs, interests and conditions of the Transboundary Aquifer community of users. The GAP will be submitted to the Project Steering Committee for technical clearance and then submitted to relevant national authorities for adoption.

Action item (A6): Monitoring and evaluation

The project will set up a gender-responsive M&E system using data disaggregated by sex, age and ethnicity, and gender-responsive indicators (**Output 5.3**). This will allow the project to keep track of all gender-related activities and assess progress in gender and minority equality and inclusion. The findings and recommendations from the water and gender analyses conducted in A1 (**Output 1.3**) will be essential inputs for the design of the M&E system.

All project reports will be reviewed to ensure that gender and minority considerations are included. For this purpose, a "gender-check" procedure will be defined and applied (**Output 1.1**).

TABLE 48: PROJECT'S GENDER INTEGRATION ACTION PLAN

Output	Responsibility	Gender, Ethnic Minorities Mainstreaming by Project outputs	Indicators and targets	Timeline	Budget
Component 1: Joint science-based diagnostic for groundwater dynamics (recharge & extraction) and effects on ecosystems (e.g. fish, wetlands) and livelihoods					USD 300 000
Output 1.1 Assessment of current state of groundwater resources, recharge and extraction dynamics	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1:** Form up an Assessment Team with equal participation from women and men officials from relevant ministries and institutions for advising and monitoring progress on gender and minority issues. **Activity 2:** Ensure gender and minority balance within representatives appointed in coordination and advisory instances. **Activity 3**: Develop and submit the Gender integration and Equality Approach for Transboundary Aquifers (TBA-GiEA) Action Plan. **Activity 4**: Mainstream gender considerations (among others, sex-disaggregated data collection) and findings from the gender assessment (1.3.) to all reports generated within the baseline study of groundwater resources, recharge and extraction dynamic, with special emphasis on women's, men's and ethnic minority roles, needs and constraints in and towards ecosystem services.	Baseline: n/a Assessment team for TDA, min. 50 percent participation from female officials. Methodology, including tools and workplan, to integrate gender and ethnic minority and conduct gender analyses along the TDA (TBA-GiEA Action Plan) developed. Gender and minority integration check ("Gender-check") developed and implemented. Different reports produced on the current state of groundwater resources, recharge and extraction dynamic among women, men and ethnic minority dependency.	1st year	Included in Component 1 budget

Output 1.2 Analysis of groundwater related dependencies of related ecosystems	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1**: Develop capacity on sex-disaggregated analysis of groundwater related dependencies of related ecosystems using gender mainstreaming in assessment cycle. **Activity 2**: Ensure different reports on the groundwater related dependencies of related ecosystems include women, men and ethnic minority considerations. **Activity 3:** Put in place an equal opportunity recruitment process for scientists and technitians.	Baseline: n/a Analysis done with sex-disaggregated data. Different analytical reports on groundwater related dependencies of related ecosystems include women, men and ethnic minority considerations. Gender-inclusive recruitment of short- and long-term job opportunities with the project, including appropriate advertisement.	1st and 2nd year	Included in Component 1 budget
Output 1.3 Agreed upon Transboundary Diagnostic Analysis (TDA), including assessment of related governance, socio-economic, legal and gender aspects	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1**: Develop the methodology for the gender analysis to be integrated in the TDA assessment including . **Activity 2**: Produce a gender, water and livelihoods assessment report on the access to and control over groundwater resources by women and men, and their recharge and extraction dynamics, considering ethnic minorities, to be included in the socio-economic section of the TDA. **Activity 3:** Elaborate a diagnostic study of gender responsiveness of water policy frameworks in both countries, to be included in the TDA.	Baseline: n/a Gender, Water and Livelihoods Assessment Report integrated in the TDA; Diagnostic study Report of gender responsiveness of water policy frameworks integrated in the TDA; Women, men and ethnic minorities fully participated in the TDA consultation and finding	1st and 2nd year	Included in Component 1 budget

		Activity 4: Ensure the equal and meaningful participation of women, men and ethnic minority in the consultation and validation of the final TDA findings.	validation process.		
Output 1.4 Agreement reached on Environmental Status Indicators	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1:** Organize participatory consultation meetings with men and women from rural communities, including representatives of IP communities and private sectors, to develop environmental status indicators, including their needs and constraints related to ecosystem services;	Baseline: n/a Women, men, communities and ethnic minority were consulted to develop environmental status indicators and signed the agreement.	1st year	Included in Component 1 budget
Component 2: Piloting solutions for improved transboundary groundwater management					USD 20 000
Output 2.1 Pilot demonstrations of innovative groundwater management & utilization after adequate feasibility studies	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1:** Ensure that 40 percent of the pilot demonstration is target female farmers and ethnic groups and managed by MoWA and the assessmsent team of relevant ministries; and are included in good practices documents; **Activity 2:** Conduct gender and minority impact analyses of the pilot demonstrations including gender disaggregated data.	Baseline: n/a 40 percent of the pilot demonstration is targeted women farmers and farmers from ethnic minority. Gender and minority impact analyses reports of pilot demonstrations.	Year 2-5	Included in Component 2 budget
Component 3: Transboundary cooperation mechanisms.					USD 20 000
Output 3.1 Harmonized design of groundwater monitoring networks and protocols	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1:** Ensure that women and ethnic minority are fairly and equally represented in the monitoring networks and protocols.	Baseline: n/a At least 40 percent women within networks and protocols, including representatives of ethnic minorities	1st and 2nd year	Included in Component 3 budget

Output 3.2. Agreement on groundwater data exchange mechanisms and procedures	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1:** Women and ethnic minorities are nominated to be part of the groundwater data exchange events **Activity 2.** Agreement on groundwater data exchange mechanism and procedure illustrates or takes consideration on gender-responsive solutions.	Baseline: n/a At least 30 percent of women and ethnic minority joined the groundwater data exchange events. Agreement on groundwater data exchange mechanisms and producers includes gender indicators and related budget targeting women's improved access and use of groundwater.	1st year	Included in Component 3 budget
Output 3.3. Design of permanent transboundary consultation and coordination body	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1:** Representatives from women's and ethnic minority's organizations are part of the groundwater permanent transboundary consultation and their concerns included in agreements; **Activity 2.** Women and ethnic groups are part of the coordination body.	Baseline: n/a Women and ethnic minority's issues are included in the consultations and agreeents. At least 40 percent of women and ethnic minority are part of coordination body of transboundary coordination body.	1st year	Included in Component 3 budget
Component 4: Joint strategies and action programs					USD 120 000
Output 4.1 Countries establish ad hoc inter-ministerial committees	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1:** Gender mainstreaming in inter-ministerial committee	Baseline: n/a Gender mainstreaming in inter-ministerial committee At least 40 percent of the members are women	1st year	Included in Component 4 budget

Output 4.2 A shared long-term Vision (horizon 20 years) including the agreement on environmental quality targets	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1.** Findings from the gender analysis and main needs and constraints from ethnic minorities included in the shared vision. Awareness raising events organized. **Activity 2.** Gender equality indicators and ethnic minority concerns are included in the shared long-term vision.	Baseline: n/a Gender mainstreaming events conducted to officials and institutions who are designing the shared vision. Gender and ethnic minority's equality targets included in the shared vision.	1st and 2nd year	Included in Component 4 budget
Output 4.3 Strategic Action Program (SAP) with horizon of 5 years, consistent with the Shared Vision	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1:** the GAP (5.3.) integrated in the SAP program **(**Strategic Action Programmes) based on the findings from the gender analysis conducted within the TDA: including (i) approaches to ensure women's leadership roles in decision-making within institutional development and coordination mechanism (ii) to include ethnic and gender-responsive indicators in programme and project design, legal frameworks, including gender analysis in consultations at local level to develop plans (iii) to include equal representation of men and women affected by water management in trainings, financial support, long-term engagement, and working in partnership with women's, Indigenous peoples, and disabled people organizations to ensure inclusive access to and control over groundwater	SAPs reviewed by the Assessment Team for ensuring gender integration; balanced gender, youth, minorities participation and equal share of project benefits. GAP should be presented in SAP. 10 percent proposed budget in SAP should go to affirmative actions towards gender equality and ethnic minority development. Women, men and ethnic minorities represented in the SAP workshops and validation process.	Year 2-5	Included in Component 4 budget
Component 5. Reinforced institutional capacity, improved participation, gender mainstreaming, monitoring and coordination.					USD 350 000

Output 5.1 Structured capacity building in groundwater governance	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1:** Capacity needs assessment considering men's and women's needs at the various levels. **Activity 2:** Develop a capacity development Plan based on modular training courses on gender and ethnicity in groundwater governance and management, and water and gender indicators for TBA **Activity 3:** Establish a Gender Focal Points system (1.1) and develop their capacity on gender and minority integration, data collection and use of indicators. **Activity 4:** Develop guidelines for integrating gender and ethnicity considerations in TBA management.	Baseline: n/a At least 40 percent trainees are women from relevant ministries. Capacity need assessment targets either women, men and ethnic minority taking into consideration their needs and constraints in groundwater management and governance. Training on gender and groundwater management, governance and indicators delivered. Gender Focal Points system is in place and trained. Guidelines on Gender and ethnicity integration into TBA developed.	Year 1-5	Included in Component 5 budget
Output 5.2 Annual stocktaking and awareness raising meetings	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1:** Develop gender awareness raising materials and disseminate in events **Activity 2:** Integrate at least 2-3 key communication massages on gender equality and ethnic minorities in TBA management **Activity 3:** Enhance women's empowerment by targeting female role models in communication **in strong collaboration with** MoWA and	Baseline: n/a At least 30 percent participant is women. Gender awareness raising materials developed and disseminated Awareness raising events on gender	Year 1-5	Included in Component 5 budget

		Assessment Team of relevant ministries **Activity 4:** Organize gender and ethnicity awareness raising event	responsive-groundwater management and governance for decision makers organized.		
Output 5.3 Gender Action Plan for sustainable groundwater management, including indicators and gender budget within the SAP adopted by both countries	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity1:** Development of GAP in groundwater management and governance by Cambodia and Viet Nam and adopted. **Activity 2:** Establish a Gender-responsive Monitoring and Evaluation (M&E) system using data disaggregated by sex, age and ethnicity, and gender-responsive indicators.	Baseline: n/a GAP developed and adopted in both countries At least 20 percent of key achievements are related to gender and ethnic minorities Gender mainstreaming in project documents and achievements. Gender-responsive Monitoring and Evaluation (M&E) system in place; gender-responsive indicators defined.	Year 1-5	Included in Component 5 budget
Output 5.4 Periodic events for the coordination with other ongoing initiatives	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1:** Collaborating and exchanging with local women projects on WASH, economic empowerment, agriculture and fisheries **Activity 2:** Coordinating with on-going initiatives, e.g., national and international stakeholders and implementing NRM, water and agricultural/fisheries activities	Baseline: n/a Coordination meetings between Water and Gender Team and women's organizations. Workshops with women's organisations in both countries organized.	Year 1-5	Included in Component 5 budget

Output 5.5. Full participation to GEF IW LEARN activities	Project Management Unit (PMU) and Project Implementation Unit (PIU) with supports from consultants, MoWA and Gender Working Groups of relevant ministries.	**Activity 1:** Gender mainstreaming on project website **Activity 2:** Within IWLearn, create a TBA Gender and Ethnicity on-line resource library to make available key resources developed by the project **Activity 3:** Document and disseminate experiences and lessons learned in GEF IW LEARN, resulting from gender and ethnic mainstreaming in transboundary aquifer (TBA) management.	Baseline: n/a Project information specifically on gender and ethnicity issues are posted on project website. TBA Gender and Ethnicity online resource library including key resources on gender, youth and minority integration into TBA, developed by the project. Gender and ethnicity development papers are published and distributed to stakeholders.	Year 1-5	Included in Component 5 budget

Annex O: Stakeholder engagement during the project preparation phase

Stakeholder engagement was the main foundation for developing the Project Document and its implementation and execution arrangements. The stakeholder engagement process for this project follows the following principles:

1) All stakeholders will be approached in the spirit of constructive collaboration and made aware of the project's purpose and potential benefits to participating stakeholders. It will be made clear at the outset that communities have the option to refuse to participate.
2) All project beneficiaries, regardless of their difference group or social status, shall be engaged in a culturally relevant way on the basis of a free, prior, and informed consultation (FIPC) aimed at establishing Broad-based and sustainable multi-stakeholder and Community Support for the project.
3) The stakeholder engagement process will take account of gender and ethnic differentiation to ensure that project implementation, including consultations, is inclusive and carried out in the appropriate language(s). Communication throughout the project cycle will use appropriate information, education, and communication (IEC) materials to respond to issues of language and ethnicity, literacy / illiteracy, gender, and social vulnerability.
4) All project-affected people will have the opportunity to participate and benefit from the project through participation in the preparation and implementation of project Action Plans.

These principles have guided the PPG phase and will continue to guide the execution phase of the project. Furthermore, the project will also uphold principles defined by national laws of Cambodia and Viet Nam, which define openness, freedom of participation and the ability to freely raise concerns without limitation or repercussions as conditions for stakeholder engagement.

TABLE 49: STATISTIC ON STAKEHOLDERS ENGAGEMENT DURING PPG PHASE IN CAMBODIA

Date of meeting	Location	Main Objective of meeting	Key groups of stakeholders present	Total participant (excl. FAO/team)	No. of Men	No. of women
16-Nov	*MOE*	Data collection, collect inputs for co-finance letter and comments for the improvement of PD	H.E Choup Paris, GDEKI	4	3	1
18-Nov	MOE		H.E Khieu Borin ,GDLC	2	2	
25-Nov	MOE		NCSD	12	10	2
24-Nov	MOE		GDANCP	2	2	
01-Dec	Zoom meeting		MAFF: GDA	5	5	
06 Dec	Zoom Meeting		MAFF: FiA	3	2	1
02-Dec	Zoom Meeting		MOWRAM: PMU, DHRW, DIA, DWSS, Head of Gender, CNMC, TSA	12	10	2
20-Nov	CNMC office		CNMC	4	3	1
17-Nov	Zoom meeting		MRD: DRWS, Head of Gender	3	3	
30 Nov	Zoom meeting		MoWA	3	1	2
26-Nov	**Svay Rieng**	(i) subnational investment plan for groundwater and wetlands, (ii) provincial priority project related to groundwater, (iii) provincial groundwater management, (iv) key tasks to address groundwater issues, (v) groundwater related risks and	PDOE	8	7	1
27-Nov			PDAFF	5	5	
27-Nov			PDRD	3	2	1
28 Nov			Field visit to community	6	5	1
03-Dec	**Prey Veng**		PDOE	4	4	
04-Dec			PDAFF	3	3	
04-Dec			PDRD	4	3	1
05- Dec			Field visit to community	6	4	2
08-Dec	**Kg. Cham**		PDOE	4	3	1
09-Dec			PDRD	3	3	
10-Dec			PDAFF	13	10	3
16-Dec	**Siem Reap**		PDOE	9	8	1
17-Dec			PDAFF	4	4	

17-Dec		(vi) required actions: Groundwater data, consumption, monitoring plan, Groundwater impacts/change to environment and ecosystems, Groundwater governance and farming system (gendered)	PDRD	4	4	
18 Dec			Field visit to community	6	5	1
23-Dec	**Sihanoukville**		PDOE	2	2	
24-Dec			PDAFF	5	5	
24-Dec			PDRD	3	3	

TABLE 50: STATISTIC ON STAKEHOLDERS ENGAGEMENT DURING PPG PHASE IN VIET NAM

Date of meeting	Location	Main Objective of meeting	Key groups of stakeholders present	Total participant (excl. FAO/team)	No. of Men	No. of women
09 Oct 2020	*Can Thơ*	Presenting CMDA Project. Improvement ProDoc. Discuss Proposals for demonstration project	*DLA, DWRM, DCC, VNMC, SIWR, NAWAPI, GD Environment,* Can Thơ City Administration, DARD Tien Giang Province, DoNRE and DARD Dong Thap Province, DoNRE CaMau Province, DOC and DARD and DoNRE Soc Trang Province, DARD Kien Giang Province, DARD and DoNRE Bac Lieu Province, DARD and DoNRE Tra Vinh Province, DARD and DoNRE Long An Province, DoNRE An Giang Province, DoNRE Vinh Long Province, DoNRE Hau Giang Province, Can Thơ University, SIWRP, RIMDD	48	37	11

Annex P: Key Stakeholders – Viet Nam

Department of Natural Resources and Environment (DONRE) plays a key role in the management of natural resources and environmental protection at the province level. Major organizations under DONRE related to groundwater management may include: Unit of Water and Mineral Resources; Unit of Meteo-hydrology and Climate Change; Unit of Environmental Protection; Unit of Land Management; and Unit of Natural Resources and Environmental Monitoring. At the district level, there is a Sub-DONRE. And at commune level there is a staff per commune responsible for land, water and environmental management. Some interests and concerns at DONRE include: Trans-boundary water needs and natural resources management in Mekong River Basin; Effective regional planning in the VMD; How to involve (difficult to involve) enterprises and other stakeholders in water management; Environmental pollution due to too much chemical uses in agriculture, wastes from industrial zones, domestic use and services; Reduction of natural wetland, mangrove forest and biodiversity; and inconsistent legal framework causing ineffective implementation. Participation of DONRE is important to carry out the project activities successfully because it has power and staff in term of land and water management in the province; it can share data and information regarding to natural resources, environmental quality, land use, etc.; it has capacity to apply technology in management of natural resources and environment.

The *Department of Agriculture and Rural Development (DARD)* plays an important role in the management of agriculture and development in rural areas at the province level. It has many divisions and centers to implement tasks and roles. Related to (ground)water use and management, below organizations should be taken into account: Unit of Irrigation; Unit of Aquaculture and Fishery; Unit of Livestock and Veterinary; Unit of Rural Development; Division of Crop production; Unit of Forestry; Center for Rural Water Supply and Sanitation; Center for Agricultural Extension; and Center for Seed Production. Like DONRE, the district level agencies are Sub-DARD, and at commune level it has 1-3 staff per commune who are responsible for irrigation, agriculture, aquaculture, fishery, forestry and rural development. Salinity, flood control, and irrigation systems for rice intensification have caused a loss of water retension areas over the past decades and intensified surface water pollution. Additionally, climate change is intensifying and droughts occur more frequent in the region. As a result, people rely more on extraction of groundwater and water table has been decreasing. There are some pilot programmes to reduce rice production and DARD organisations focus on selecting alternative crops. These efforts demand more research to identify and test better strategies and technologies for alternative crops, which are more water use efficient and also marketable. Consequently, DARD should be a key partner in this project. It may be engaged in many ways: Provide technical and experienced staff; Implement and monitor demonstration projects and transfer of technology; Connect with farmers and private companies for better collaboration; Co-operate with their current projects and programs (agricultural extension, new rural development, one commune - one product, etc).

The *Program Coordination Office of the National Target Program on New Rural Development (PCONRD)*: Viet Nam has implemented the National Target Program on New Rural Development. Under this program the Program Coordination Office of the National Target Program on New Rural Development (PCONRD) has been created in each province with representations also at the district and commune level. The PCONRD is responsible for effective implementation of 19 criteria in the new rural development program covering five major aspects of the society including (i) rural area planning; (ii) socio-economic infrastructure; (iii) economy and production organization; (iv) culture, society, and environment and (v) political system (Kien and Minh, 2015). Sustainable management of groundwater resource is closely linked to this Office's activities, improving rural livelihoods and environmental protection.

The *Department of Labors, Invalids and Social Affairs (DOLISA)*: DOLISA performs state management functions in the following areas of labor, wage and salary, employment, vocational education, social insurances, occupational safety and hygiene, people with special contribution to the country, social protection, children related issues, gender equality, social vices control and prevention in the provice. At district level

exists a Sub-Department of Labors, Invalid and Social Affairs (Sub-DOLISA). At commune level exists a staff per commune responsible for the related issues. DOLISA has concerns on high poverty rate, especially in remote areas and minority groups; low education of the poor, they do not have knowledge on health protection, safety when spraying pesticides while this is a key income source of the poor; chemical use in agriculture ⇔ health related issues and environmental pollution; not attract young labors in the province due to low quality of vocational education, less job opportunities, low income compared to South East provinces; migration to cities, industrial parks and oversea (exporting labors). DOLISA contributes to carry out activities related to poverty reduction, children, gender, minority groups, vulnerable people, and vocational education. Such activities can lead to improvement of rural livelihoods, especially vulnerable groups, then put less pressure on ground water use.

The *Vietnamese Farmer's Union (VNFU)* is a social-political organization of Vietnamese peasantry under the leadership of the Communist Party. VNFU has been playing a key and central role in farmers' movements and building new rural areas. Currently, about 80-90 percent of rural HHs are VNFU members. VNFU has a solid structure from central to grass-root level. There are about 20 staff at provincial level, 3-5 staff per district, 3-5 staff per commune, and some groups at hamlet levels. Under VNFU's point of view, there are key problems such as small scale farming, too much chemical use, conventional practices, difficult to change farmers behavior; weak collaboration among 4 stakeholders (government-enterprise-scientist-farmer); climate change impacts, salinity intrusion, floods, erosion, diseases on crops, livestock, fish, shrimp; fluctuation of agricultural product prices; migration to cities, industrial parks; weak human resources (qualified) in VNFU system at all level. As mentioned, VNFU has good structure at the grass-root level with representative staff from center to province, district, commune and hamlet. This structure can be used to increase farmer awareness under project implementation and after. VNFU has collaboration with related Departments and good networks in the provinces. VNFU has its own budget (farmer supporting funds) to help farmers.

The *Vietnamese Women's Union (VNWU)*: Similar to VNFU, VNWU has the same role as a social-political organization but focusing more on women and children. It also has the same structure, organizing from national level to provincial, district, commune and hamlet. VNFU interests and concerns include: contamination, unsafety food, chemical residue on vegetables, fruits cause health related issues, especially for women and children; water pollution, climate change affects to women and children; lack of knowledge on climate change; vocational education for women, ensuring stable jobs, high income; unstable prices of agricultural products affect to women living conditions; improve roles of women in family and society. Similar to VNFU, VNWU has good representation at the grass-root level with staff from center to province, district, commune and hamlet. VNWU has collaborations with related Departments. VNWU has its own budget to support women and children.

The *Agricultural Cooperative* is considered as a production unit and operated under Law of Cooperative. There are about 80-100 agricultural cooperatives per province. Each cooperative has 1 director, 2-3 vice-directors and around 20-30 members. The cooperatives have been managed and supported by DARD, VNFU and Viet Nam Cooperative Alliance. Their key role is getting farmers together for large scale production, better incomes, easier to implement governmental policies. It is noted that beside cooperatives, there are farmers' clubs which are considered as an early stage of cooperative. Their concerns are low education, lack of skill and knowledge, lack of strategy and planning, less effectiveness, contract farming broken, etc. Agricultural Cooperatives are of importance for area-based management of groundwater use in an efficient way.

Non-Governmental Organizations (NGOs): There are many NGOs working in the Mekong Delta such as WB, UNDP, FAO, GIZ, IFAD, etc. Their interests and concerns cover sustainable agriculture, organic agriculture, aquaculture, forestry, water governance, climate change adaptation, gender, socio-economic development, etc. NGOs often add a critically important point of view, can provide large networks, and can influence transboundary negotiations.

Annex Q: Key Stakeholders – Cambodia

Department of Rural water supply and sanitation of the Ministry of Rural Development (MRD).

Department of Rural water supply and sanitation play key role in supply clean and good water for rural household in Cambodia including providing wells and promote hygien. At provincial level, there is a provincial department of rural devlopment undertaking the implmentation of national key priority. Interests: Groundwater monitoring, groundwater mapping, groundwater master plan and identify potential areas for grondwater well installation. Concerns: on reducing of groundwater quality and quantity and Insufficient water supply for rural areas and not safe water for rural community. Department of Rural water supply and sanitation should be involved in this project by many ways:Mandated in managing all rural wells installation, mangment and mainternance. Manage most of the groundwater development in rural community; and this department has sufficient knowledge and data on groundwater and water supply in rural community.

Department of Planning and Statistics (DPS)-MAFF. DPS-MAFF manage all statistical information and detailes planning on agrictulutre sector in Cambodia . At provincial level, the department has channels for data collection and undetaken the data mining on agricluture planning and development. Interests: DPS-MAFF wish to intergrate data related to the groundwater information in the agriculture sector and concret plan on groundwater uses planning for agriculture sector. Concerns: on reducing of groundwater quality and quantity for agriculture production in rurul community. Also, Lack of avaiablle water supply for agricutlure areas and irrigation especially during dry season. DPS-MAFF has potential role in engagment in the project by providing clear strategic development plan for agriculture sector using groundwater resources. This department also have avaialbe data and information which will be requried for the implemetnation of the detail dianostic study and preparation of SAP in the project.

General Directorate of Agriculture (GDA) -MAFF. GDA plays key role in agricultural land mangement and devleopment including crop management and planning, soil fetilitiy mangment and devleopment, and devleopment of national strategy for agriculture development, soil featility mangment and crop zoning and planning. Interests: GDA-MAFF wish to develop crop planning and agriculture production planning using the groundwater information. Devleop groundwater mapping for rice production zoning. Concerns: on reducing of groundwater recharge and high rate of groundwater extraction and impact of climate changs to reduce the soil fetilities for the non-irrigated area. GDA can engage with the project by providing national perspective and planning for crop zoning and management of agriculture land zoning. GDA can assist the proejct for devleopment of national Strategic action programme coping with national strategy on agriculture and crop development zoning. GDA-MAFF also can provide all necessary data and maps related to soil fetility, crop zoning, agriculture development zoning.

Fisheries Administration – FiA-MAFF. FiA manage the fishery resources mangment including wild and aquaculture including the fishing lots in Cambodia. FiA also manage two important national institute on fresh and marine fishery in Cambodia. FiA also manage the local fishery communities in Cambodia and protection of fishery and ecological functions in Cambodia. Interests: FiA intersted in conservation of fishery and aquatic resoruces and alos intersted in groundwater uses for aquaculture production. Concerns: rapid losing of wetland site and aquatic resources due to the development in Mekong Basin. Also the in-balance of groundwater rechage and extract which will be leading to the losing of fishery and aquatic habitat and ecosystem services in Cambodia. FiA is playing vital role in the groundwater project especially related to dianostic assessment and development of SAP for consevation of wetland and aquatic habitats in Cambodia. FiA can also help to provide strategic guidance on the impact assessment of groundwater uses on envrionmental, ecological resources and intergrate the SAP into national actions plan. FiA also can share many improtant fishery and aquatic resources dataset for the project assessment and development of strategic actions program.

Department of River work and hydrology (DRWH)-MoWRAM. DRWH manage the hydrology and river monitoring data and information in Cambodia. DRWH also provide technical services for realtime monitroing of river water level, flood and drought monitoring and forecasting. DRWH also work on monitoring of river sediment and dicharge in Cambodia. Interests: DRWH interstred in monotring of groundwater resoruces in realtime and comparision between the groundwater and surface water level. DRWH wishes to extend more application of using groundwater in IWRM in Cambodia. Concerns: there are lack of groundwater monitoring system in Cambodia. The reason of reduction of groundwater dynamic is uncleared due to no systematic of groundwater monitring. DRWH will playing important role in the project in many ways incuding: Technical support and guidnace on interlink between groundwater and surceface water monitoring system, Assist in project dianostic study on groundwater dynamics changes using both groundwater and surface water assessment and Share data and information related water resources and hydrology.

Department of Irrigation (DOI)-MoWRAM. DOI is mnanated in irrigation development in Cambodia including the development of national strategy and plan for irrigation project development and imporvement. Interests: DRWH interstred in using of intergrated groundwater resources and ririgation system for drought prone area. Concerns: limited of knowledge and understanding about groundwater resrouces and how these link with irrigation system and how to intergrate both resources for support farmer and rural poor. DOI will playing important role in many ways of the project incuding: Devleopment of national SAP on using of groundwater resoruces intergrated with national irirgation system, Assist in implmentation of Joint science-based diagnostic for groundwater dynamics (recharge & extraction) and effects on ecosystems (e.g. fish, wetlands) and livelihoods.

Cambodia National Mekong Committee (CNMC) . CNMC is mandated national institution operating under direct supervision of the Royal Government of Cambodia, for coordinating the management, preservation, conservation and development of water and other related resources in the Mekong River Basin. CNMC interstred in transboundary groundwater cooperation, devleopment of groundwater strategy and actions plan and join scientific assessment of groundwater dynamic between Cambodia and Viet Nam which is mandated under MRC cooperation framework. CNMC concerns on no concret action on tranboundary groundwater cooperation has been developed. There many knwoledge gaps on groundwater infromation including monitoring data and maps and limited of planning on management and devleopment of groundwater resources. CNMC can engage in the project in varous important roles such as:

- Support on the joint scientific dianostic study on groundwater dynamic
- Assist as national coordinator for devleopment of Transboundary cooperation mechanisms
- Provide technical advices and gudiance on Transboundary cooperation mechanisms
- Assist in implmentation of pilot study
- Assist in devleopment of national Joint strategies and action programs on groundwater resoruces
- Interlink and coordiated with MRC framework and other MRC member countries
- Cooridated in data and infromation sharing with relevant line agencies.

Tonle Sap Authority (TSA). TSA is manded to provide technical assistance to RGC on research and developmet of Tonle Sap catchment and deveopment of national strategy and actions plan for management of Tonle Sap river and great lake. TSA is intersted in application of groundwater management in Tonle Sap areas and monitoring and assess the relationship of groundwater changes with water levels in the lake. TSA concerns on the limited of groundwater data and activities related groundwater monitoirng and mapping of groundwater quality and quantity. TSA can engage in the project by providing strategic advices on the implmentation of the Joint strategies and action programs on groundwater resoruces and coordination in the implmentation of pilot study in the Tonle Sap surrounding proivnces as well as sharing data and information for the proejct.

General Directorate of Environmental Knowledge and Information (GDEKI)-MOE. GDEKI is manated in manamgent of environtal and its related database and information. GDEKI also support in coordination and facilition on promoting and educating the enviornmetnal information in Cambodia. Need joint trans-boundary environmental management related to groundwater dynamic changes. GDEKI needs to the establsihment of groundwater resources database and promoting the suitable uses of groundwater efficiency for balancing with wetland and habitate management and conservation. GDEKI is concern Environmental pollution; Reduction of wetland, forest, biodiversity; Inconsistent legal framework. GDEKI can be engaged in the proejct implmentation in many ways including:

- Coordinate and faciliate the proejct implmentation with relevant national agencies.
- Provide technical advices and guidance on Joint strategies and action programs on groundwater resoruces.
- Support in devleopment of Transboundary cooperation mechanisms.

Department of Freshwater wetland conservation (DFWC) of MOE. DFWC is manated in conservation of national freshwater wetland in the consevation zone under Ministry of Environment. DFWC is also develop national strategy and action plan on wetland conservation in Cambodia. DFWC is intersted in application of groundwater in wetland area and what are the releationship between groundwater changes with wetland area. DFWC is concerns on: rapid changes of freshwater wetland and losing of natural habitate due to rapid changes of surface water flow and reduction of groudnwater table. DFWC can provide technical assistance in implmenting the follwing key actions:

- Support on the joint scientific dianostic study on groundwater dynamic
- Assist in implmentation of pilot study
- Assist in devleopment of national Joint strategies and action programs on groundwater resoruces
- Provision of data and infromation related to freshwater wetland.

National Council for Sustainable Development (NCSD) of MOE. NCSD is mandated in promoting the national sustainable devleopment plan for varous sector including climate change, biodiversity conservation, greengrowth, including promtoing the use of science and technology for enviornmetnal mangment and protection. NCSD is intersted in application of groundwater management for better and sustainable biodiversity management and promoting efficiency of grounwater uses for better environemtnal management and protection. NCSD is concerned on: rapid changes of freshwater wetland and losing of natural habitate due to rapid changes of surface water flow and reduction of groudnwater table. Impact of groundwater quality on natural biodiversity functions and people health. NCSD can provide support on devleopment of national Joint strategies and action programs on groundwater resoruces and Reinforced institutional capacity and devleopment of national policy and planning related to substainable use of groundwater resources.

Department of Climate Change (DCC) of MOE. DCC is mandated on coordination and facilitation on climate change mangment, policy formulation and national strategy on climate change mangment and mitigation. DCC instreated in impact of climate change on groundwater resoruces and how to solve the reduce the impact? The DCC is concerned on: rapid changes of surface water flow and reduction of groudnwater table due to frequence climate variation in Mekong Basin. Impact of climate change in groundwater quantity and quality. DCC can enguage in the proejct for multiple roles and functions including:

- Support and provide techncial assistance in the joint scientific dianostic study on groundwater dynamic related to climate change
- Support on development of national strategy and action plan of groundwater addressing the issues of climate change
- Intergrated SAP of the proejct into the national strategy and actions plan for climate change management and adaptation.

Ministry of Women's Affairs (MWA).MWA are the national machinery for the promotion of gender equality and women's empowerment in Cambodia. MWA acts as a catalyst and advocate to encourage public institutions, civil society and the private sector to integrate gender equality into their policies and programs,

and as a coordinator and facilitator for gender mainstreaming across government. It is responsible for monitoring and evaluating policies and programs to assess their contribution to achieving the Government's goals in promoting gender equality and the empowerment of women. MWA instreated in gender mainstreaming and actions plan.MWA is concerned on: gender inequality in groundwater users communities and in balance between role of men and womend in mangment of groundwater uses and water supply in rural community. MWA can enguage in devleopmet of national policy and planining by mainstreaming of gender issues in the national and regional plan.

CAVAC Innovation Agriculture. CAVAC support the RGC to improve, quality, sustainabiolity and effiectivness of irriation system in Cambodia Innovation of irreigation system Sustianble irrigaiton services to community and provide advisory on demand driven on irigation infrastructure investment and policy. CAVAC can share experiences, Support on policy fourmulation and planning and Assess the irrigation and groundwater demand for local community.

Cambodia Water Partnership (CWP).CWP is a part of global Water Partnership Southeast Asia is one of the region in the international network which created to foster an integrated approach to water resources management (IWRM).IWRM approach intergration, Water resources networking,Tranboundary cooperation machanism , Water governance. CWP can share experiences, Providing scientific experts and technical input for joint scientic dianostic study, Participate in the demonstration project sites, demonstration and assist on collaborating with the local governments and departments.

National universities and research Institutes. Universities and research institutes in Cambodia play an important role in research and education related to groundwater, biodiversity, ecology and fishery. New finding on groundwater research, Promote Sustainable development and assess the ecosystem serices and functions of wetland related to groundwater dynamics. The national university and research institute can also share good experiences, Providing scientific experts and technical input for joint scientic dianostic study, Participate in the demonstration project sites, demonstration and collaborating with the local governments and departments.

NGOs and IGOs.There are many NGOs working in the Cambodia as well as IGOs (e.g. MRC, WB, UNDP, ADB, GIZ, IFAD, OXFAM). NGO and IGOs can provide support in many area incuding: Water resoruces management and IWRM, Tranboundary cooperations machanism, Sustainable management of agriculture, fishery, forestry, water governance, climate change adaptation, gender, socio-economic development, etc. NGOs and IGOs can also sharing experiences; Sharing available data, and information and planning, Joint Collaboration on some related project activities; and can help to promote water governance and stakehoder participation as well as asist in promote gender mainstraming in our project implmentation processess.

Annex R: Terms of Reference of key staff and consultants

Position Title	*Agency*	*Estimated Person Months*
PROJECT MANAGEMENT UNIT		
Chief Technical Advisor (SP)	IUCN	60 Man Months

Under the overall supervision of IUCN as Lead Operational Partner, and in close coordination with the National Project Directors in Cambodia and Viet Nam, the CTA will be responsible for ensuring that the project is executed with high technical standards, including providing high level advice, in coordination with UNESCO, the international and national consultants/experts, and will work in close cooperation with FAO and the technical supervision of FAO's Lead Technical Officer. The CTA will play a key role in building institutional transboundary coordination and strengthen local and regional river basin management capacities. The CTA is expected to play a lead role in overseeing day-to-day management of the project as well as the technically oversee and contribute to all outcomes, as follows:

Project Management Tasks (22 percent - PMC)

- Lead the project team in building consensus among countries on key transboundary issues and concerns, and strengthen transboundary cooperation, information exchange, and coordination mechanisms;
- Lead the design and implementation of on-ground pilot demonstrations and the dissemination of pilot results;
- Build institutional capacity through training of national staff and partners through on-the-job training and use of international best practice;
- Maintain linkages with other related regional and national projects and identify opportunities for partnership, technical collaboration and knowledge exchange with other agencies, organizations and donors.
- Monitor, and regularly report on the progress of the project against annual work plans, project M&E indicators, GEF core indicators and identify issues that need urgent attention by the regional PSC.
- Oversee subcontracting of project activities.

Technical Tasks (77.8 percent - Components)

- Provide technical inputs and review to the assessment of groundwater resources and dependencies of related ecosystems, the TDA and contribute to the agreement in environmental status indicators (Outcome 1)
- Provide technical inputs on pilot implementation (Outcome 2).
- Draft the TORs for the Transboundary Consultation and Coordination body (TCCB) (Outcome 3).
- Draft the TORs for the establishment of the Joint Technical Committees (JTCs) and ad hoc inter-ministerial committees (IMCs); provide technical inputs for the development of a shared long-term vision; draft the Strategic Action Program (SAP) (Outcome 4)
- Provide technical inputs and review the capacity building materials, the materials for the annual stocktaking meetings, PSC meetings and other events (Outcome 5).
- Provide technical inputs to TORs for subcontracting. and consultancy outputs.
- Technically review all project outputs.

Required skills and expertise:

- An advanced university degree (MSc or PhD) in a subject related to natural resource management or environmental sciences.

- At least 10 years of experience in natural resource management and/or transboundary water resources management, hydrology, Integrated Water Resources Management (IWRM), water-related hazard/ risk reduction, as well as climate change adaptation and resilience.
- At least 8 years of demonstrable project/programme management experience.
- At least 5 years of experience working with ministries, national or provincial institutions that are concerned with natural resource and/or environmental management.

Competencies
- Strong leadership, managerial and coordination skills, with a demonstrated ability to effectively coordinate the implementation of large multi-stakeholder projects, including financial and technical aspects.
- Ability to effectively manage technical and administrative teams, work with a wide range of stakeholders across various sectors and at all levels, to develop durable partnerships with collaborating agencies.
- Ability to coordinate and supervise multiple Project Implementation Units in their implementation of technical activities in partnership with a variety of subnational stakeholder groups, including community and government.
- Strong drafting, presentation and reporting skills.
- Strong communication skills, especially in timely and accurate responses to emails.
- Strong computer skills, in particular mastery of all applications of the MS Office package and internet search.
- Excellent command of English, working knowledge of Kmher and/or Vietnamese.

Location: Ho Chi Minh City, Viet Nam

National Coordinators (Cambodia & Vietnam), P2	IUCN	120 Man Months

Under the overall supervision of the CTA, the National Coordinators in Cambodia and Viet Nam respectively, and in close collaboration with international and national technical specialists and the National Project Directors, will be responsible for daily supervision of the management and implementation of project activities in the respective countries. The National Coordinator Viet Nam will play a key role in the coordination, management and delivery of quality outputs from national experts and consultancies contracted by the project.

Project Management Tasks (27.8 percent - PMC)
- Lead the in-country implementation of project activities in close collaboration with the PSC and National PMU in Viet Nam, plus the National Coordinator and project teams in Cambodia (under the close supervision of the CTA);
- Liaise with relevant project stakeholders, including the Governments of Cambodia and Viet Nam, research institutes/organisations, local NGOs and civil society;
- Establish working relations with appropriate national agencies and groups to ensure effective implementation of supported activities, and ensure adequate information flow, discussions and feedback among the various stakeholders of the project.
- Maintain linkages with other projects and studies relevant to the project and identify opportunities for partnership, technical collaboration and knowledge exchange with other agencies, organizations and donors;

Technical Tasks (72.3 percent - Components)

- Provide technical review of project outputs and adherence to Cambodia's and Viet Nam's law, standards and norms respectively (Outcomes 1, 2)
- Provide technical inputs on the adherence to Cambodia's and Viet Nam's law, standards and norms respectively, of the harmonized design of the groundwater monitoring network and protocols, the groundwater exchange mechanism and procedures (Outcome 3).
- Provide technical inputs to the national priority legal, institutional and policy reforms and investments in Cambodia and Viet Nam respectively, for the Strategic Action Program (SAP) (Outcome 4)
- Provide technical inputs to the capacity building materials, the materials for the annual stocktaking meetings, PSC meetings and other events (Outcome 5).
- Provide inputs for the six-monthly and annual written reports on the overall project delivery, covering issues such as project activities, outputs and outcome delivery;
- Manage the delivery and performance of consultancy subcontracts in Cambodia and Viet Nam;

Mimimum Qualifications:

- An advanced university degree (MSc or PhD) in a subject related to natural resource management or environmental sciences.
- At least 7 years of experience in one of the following fields: Natural Resources Management (NRM), IWRM, Rural Development, transboundary water resources management, water-related hazard/ risk reduction, and climate change adaptation and resilience.
- At least 5 years of demonstrable project/programme management experience.
- At least 5 years of experience working with ministries, national or provincial institutions that are concerned with natural resource and/or environmental management in Cambodia and Viet Nam respectively.
- Fluency in English and in the official country language (Khmer and Vietnamese respectively)

Location: Phnom Penh, Cambodia; Ho Chi Minh City, Viet Nam

Technical Support Officers (Cambodia & Viet Nam), P2	IUCN	183 Man Months

Administrative tasks (37.6 percent - PMC)

- Provide administrative, financial and operational support to the Regional and National PMU for activities conducted in Cambodia and Viet Nam, respectively.
- Maintain the project's financial accounts and reporting in Cambodia and Viet Nam respectively, in compliance with IUCN and FAO procedures, and GEF requirements.
- Oversee the project's procurement of goods and services for compliance with IUCN and FAO procedures, and GEF requirements.

Technical Support Tasks (62.4 percent - Components)

- Support the delivery of Outcomes 4 and 5
- Under direction of NCs, assist stakeholders with task preparations for visioning and SAP workshops (O4);
- Assisting the NCs with coordinating, reviewing and collating inputs to the SAP from multiple stakeholders (O4);
- Assisting the NCs with quality control of training materials prepared by consultants for capacity building program (O5)
- Assisting NCs with stakeholder monitoring and evaluations of capacity building and awareness raising events (O5)

- Ensuring local language translations of project documentation and language interpreters for all workshops and communications (O4 and O5) are available.

Minimum Qualifications:

- University degree in Finance, Administration or related fields.
- 5-8 years of experience in at least one of the following areas: project management, technical support, financial and/or administrative project support, project monitoring and evaluation.
- Strong communication skills, especially in timely and accurate responses to emails.
- Strong computer skills, in particular mastery of all applications of the MS Office package and internet search. Experience with CRM and/or project management software desirable.
- Fluency in English, working knowledge of Kmher and/or Vietnamese.

Location: Phnom Penh, Cambodia; Ho Chi Minh City, Viet Nam

Administrative Officer	UNESCO	4 Man Months

Administrative tasks (100 percent PMC)

- Provide part-time administrative support to activities implemented by UNESCO, in the framework of the project.
- These may include issuing and monitoring of contracts, monitoring of project budget, as per UN-to-UN agreement and GEF requirements.

Minimum requirements:

- University degree in Finance, Administration or related fields.
- 5-8 years of experience in project administration and support, preferably for multi-country projects.
- Strong communication skills, accuracy, ability to respond to tight timelines and deadlines.
- Strong computer skills, in particular mastery of all applications of the MS Office package and internet search. Experience with CRM and/or project management software desirable.
- Demonstrated initiative, good judgment and ability to organize office work;
- Fluency in English.

Location: Jakarta, Indonesia or Paris, France

Support Assistant (GS)	UNESCO	5 Man Months

• Provide operational support for activities under Outcome 5, supporting the Technical Officers engaged, including organizing trainings, undertaking logistical preparations, preparing agendas and materials for trainings.

Minimum Requirements:

- Secondary school education, including or supplemented by courses in general administration or related training;
- A minimum of 4 years of clerical experience of which at least 2 years related to the implementation of larger program or projects.
- Demonstrated knowledge of project operations procedures;
- Demonstrated initiative, good judgment and ability to organize office work;
- Strong computer skills, in particular mastery of all applications of the MS Office package and internet search. Experience with CRM and/or project management software desirable.
- Fluency in English.

Location: Jakarta, Indonesia or Paris, France

PROFESSIONALS		
Water Governance and Policy Engagement Advisor (M1)	IUCN	5 Man Months
• Provide technical inputs, advice and guidance on the project's activities related to groundwater governance at national and transboundary levels; • Facilitating dialogues on a groundwater transboundary governance framework; • Support the project team with the design of project specific and long-lasting governance mechanisms for dialogue and joint decision-making.		
Agro-ecologist - Agriculture/Aquaculture, Climate Change and NBS (SP)	IUCN	7 Man Months
• Support the CTA, National Coordinators and TDA teams with technical inputs, advice and guidance on NBS in agriculture and aquaculture landscapes in relation to groundwater pumping and recharge.		
Hydrologist - Agriculture, Irrigation, and IWRM (SP)	IUCN	7 Man Months
• Support the CTA, National Coordinators and TDA teams with technical inputs, advice and guidance on IWRM in relation to irrigated agricultural landscapes.		
Ecologist - Wetlands and NBS (SP)	IUCN	3.5 Man Months
• Support the CTA, National Coordinators and TDA teams with technical inputs, advice and guidance on wetland conservation and management in relation to conserving aquifer recharge area.		
Community Engagement Specialists - Livelihoods and Climate Change Adaptation (Cambodia & Viet Nam) (P1)	IUCN	6 Man Months
• Support the Cambodia and Viet Nam National Coordinators with community level engagement including awareness raising events, community level training on groundwater issues, and C2 pilot implementations in in Cambodia and Viet Nam respectively.		
Communications & Knowledge Management (P2)	IUCN	20 Man Months
• Prepare Project-specific Communications and Knowledge Management (CKM) Strategy and associated work plans; • Liaise with Project staff and partners to collect requisite information and content on Project activities and achievements; • Develop project visual identity and related visibility and outreach material • Prepare, process, document and disseminate information and communication products, including outreach and awareness-raising materials, through available channels; • Create and curate content of project website and provide input to IWLEARN; • Supervise the development of all Knowledge Management outputs		

Minimum Qualifications:

- Advanced university degree in journalism, communications, public relations or related field
- Five years of relevant of experience working with strategic and/or project communications
- Fluency in photo and video processing, website maintenance, social media curation.
- Fluency in English, written and oral.

Technical Advisor (part time)	UNESCO	24 Man Months

- Develop comprehensive and consolidated workplans for the projects, in close collaboration with the UNESCO field offices.
- Provide technical support for the preparation of project strategies, policy and operational development.
- Provide technical advice for the design and implementation of activities within the projects.
- Liaise with the Chief Technical Advisor to ensure coherence and soundness of all project activities.
- Ensure consistent delivery of all UNESCO led activities according to timeline and budget and provide all inputs to partners as required for the project coherent delivery.
- Prepare technical reports/policy documents required by the project in a timely manner;
- Monitor, and regularly report on the progress of the project against annual work plans, project M&E indicators, GEF core indicators and identify issues that need urgent attention by the regional PSC.

Minimum qualifications:

- An advanced university degree (MSc or PhD) in a subject related to natural resource management or environmental sciences.
- At least 10 years of experience in natural resource management and/or transboundary water resources management, hydrology, Integrated Water Resources Management (IWRM), water-related hazard/ risk reduction, as well as climate change adaptation and resilience.
- At least 5 years of experience working with ministries, national or provincial institutions that are concerned with natural resource and/or environmental management.
- Fluency in English.

Location: Paris, France

Technical Project Officers (Cambodia, Viet Nam, Regional Office for Asia and the Pacific)	UNESCO	130 Man Months

- Provide technical advice and support under the guidance of the Technical Advisor to activities implemented by UNESCO on the ground in Cambodia and Viet Nam respectively;
- Provide support for the creation of national workplans.
- Provide support for the monitoring, and regular reporting on the progress of the project against annual work plans, project M&E indicators, GEF core indicators and identify issues that need urgent attention by the regional PSC.
- Ensure subregional coordination of the project activities.

Minimum qualifications:

- An advanced university degree (MSc or PhD) in a subject related to natural resource management or environmental sciences.

• At least 5 years of experience in natural resource management and/or transboundary water resources management, hydrology, Integrated Water Resources Management (IWRM), water-related hazard/ risk reduction, as well as climate change adaptation and resilience. • At least 3 years of experience working with ministries, national or provincial institutions that are concerned with natural resource and/or environmental management. • Fluency in English. Fluency in one of the country languages, Khmer and Vietnamese desired. Location: Phnom Penh, Cambodia; Hanoi, Viet Nam; Jakarta, Indonesia		
INTERNATIONAL CONSULTANTS		
International Experts on Groundwater Management (2 hydrogeologists/1 per country, 2 GW monitoring experts/1 per country, 2 GDE experts/1 per country)	UNESCO	36 Man Months
Provide technical support on groundwater management, monitoring and groundwater dependent ecosystems (GDE), ecohydrology, etc.		
International experts in Water Governance and Water Law (2 experts)	UNESCO	12 Man Months
Support to the TDA national teams, on water governance and water law issues.		
International socio-economic expert (1 expert)	UNESCO	5 Man Months
Working in close cooperation with the technical expert-team, the socio-economic expert will be responsible for undertaking an assessment of the socio-economic situation in the Cambodia-Mekong River Delta Aquifer.		
International Gender Expert	UNESCO	40 Man Months
Leads the execution of the CMDA Gender Mainstreaming Strategy across all components including all tasks relevant to the Gender Assessment and Action Plan.		
Communications consultant	UNESCO	3 Man Months
Prepare, process, document and disseminate information and communication products for UNESCO led project activities, including outreach and awareness-raising materials, in liaison with the Project Communication & Knowledge Management Officer.		
LOCAL CONSULTANTS		
National Experts on Groundwater Management [12 experts]	UNESCO	96 Man Months
• 4 hydrogeologists/2 per country, • 4 GW monitoring experts/2 per country,		

• 4 GDE experts/2 per country • Support to the TDA team on all several aspects of groundwater management, monitoring and groundwater dependent ecosystems (GDE).		
National experts in Water Governance and Water Law [2 experts; 1 in Cambodia and 1 in Viet Nam]	UNESCO	24 Man Months
Support to the TDA national teams, on water governance and water law issues.		
National socio-economic experts [2 experts; 1 in Cambodia and 1 in Viet Nam]	UNESCO	24 Man Months
Support to TDA national teams on socio-economic analysis.		
National communications consultants	UNESCO	3 Man Months
Support communications of UNESCO led project activities, including gathering information, drafting communication and outreach pieces from a national perspective, in liaison with the Project Communications & Knowledge Management Officer.		
National Senior Gender and Water integration Experts, [2 experts; 1 in Cambodia and 1 in Viet Nam]	UNESCO	32 Man Months
Following guidance from the lead international expert, NGWEs are responsible for all gender related activities at country and transboundary levels, including development of GAPs.		
National Gender experts/Data collection [2 experts; 1 in Cambodia and 1 in Viet Nam]	UNESCO	36 Man Months
Under NGWE supervision, and overall guidance from the international expert, NGEs ensure the collection of relevant data, including sex-disaggregated ones, and the flow and quality of information across all activities.		
National Field Assistants, [2 experts, [2 experts; 1 in Cambodia and 1 in Viet Nam]	UNESCO	20 Man Months
Support to NGEs in the collection of relevant field data, including sex-disaggregated ones.		
Justification for travel, if any:	Project Technical staff and consultants may be required to travel to the FAO Regional Office for Asia and the Pacific or the Country Offices in Cambodia and Viet Nam premises to discuss execution of the activities and	

	programmatic issues. Moreover, the consultants may be also required to participate and contribute to some of the Project Steering Committee and Annual Stocktaking Meetings as relevant. They may also be required to travel to the field for meetings, consultations and monitoring of implementation of activities.