CLIMATE ADAPTIVE IRRIGATION AND SUSTAINABLE AGRICULTURE FOR RESILIENCE (CAISAR) AIIB PPSF GRANT S0452A, CODE 00-452-PPSF-DTA

ENVIRONMENTAL, SOCIAL, AND CLIMATE IMPACT ASSESSMENT REPORT

NON-TECHNICAL SUMMARY

Submitted To:

Project Management Unit
Ministry of Water Resources and Meteorology,
AIIB and IFAD

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1. INTRODUCTION

1.1 Project description

The Climate Adaptive Irrigation and Sustainable Agriculture for Resilience (CAISAR) project is under the management of the Project Management Unit (PMU), leading by a steering committee chaired by the Ministry of Economy and Finance (MEF) whereas Ministry of Water Resources and Meteorology (MOWRAM) is the executing agency, responsible for overall management of the project and implementation of Component 2 (Infrastructure) whereas the National Committee for Sub National Democratic Development (NCDD) is the implementing agency for component 1. The CAISAR project will be co-financed by the Asian Infrastructure Investment Bank (AIIB), International Fund for Agricultural Development (IFAD), and Green Climate Fund (GCF) along with in kind contribution of the Royal Government of Cambodia.

The projects' intention is to increase climate adaptation, mitigate the negative impact of extreme climate events, and improve the livelihoods of smallholder farmers and vulnerable rural communities in four (4) provinces of Cambodia, including Pursat, Kampong Chhnang, Kampong Speu, and Kandal. The project's Theory of Change is premised on the experience that addressing the complex impacts of climate change on rain fed and irrigated agriculture requires action at three levels; farm level; irrigation scheme level and at the national level for creating a strong institutional base and an enabling environment.

The CAISAR project will adopt a three-pronged strategy to bring about a paradigm shift in the farming systems and the water management governance in Cambodia. The integrated actions combining the various elements of the strategy can have a transformative impact on reducing vulnerability of water and agriculture systems to climate change impacts while also reducing GHG emissions and enhancing the livelihood of rural populations who primarily depend on agriculture.

The project will be implemented through various activities organized under three components.

- **Component 1: Improving farm-level climate adaptation, resilience, water use efficiency** focuses on climate resilient crop-water management practices, improve food security and income generation through strengthening and improving adaptive capacity and climate resilience focusing on rice, vegetable, poultry, and aquaculture production,

providing opportunities for greater market integration and agro-meteorological information and services.

- **Component 2. Upgrading and climate-proofing of water infrastructure for increased resilience** will focus on modernization of irrigation schemes and ponds, flood-proofing and drainage improvements and establishment and training of Farmers Water Users' Communities (FWUC), and
- **Component 3. Institutional Strengthening which aims to strengthen Government institutions,** mainly the MOWRAM, Ministry of Environment (MoE) and the National Committee for Sub-National Democratic Development (NCDD) and the FWUC. While the focus for MOWRAM will be on up-grading technical capacity in various aspects of CR irrigation design and management, key focus area for MoE will be on strengthening climate policies and strategies and in building capacities for monitoring climate actions at national level.

1.2 Project Area and Beneficiaries

The CAISAR project covers a total command area of 22,051 ha and is composed of six sub-schems – Ou Ta Paong (Pursat Province), Lum Hach (Kampong Chhnang Province). Brambei Mom (Kampong Speu province), Krapeu Troum (Kampong Speu and Kampong Chhnang), Yutasas (Kampong Chhnang), and Steung Krang Bat Kampong Speu and Kampong Chhnang.

Table 1 (below) provides a summary of project communes (by district and province) that each sub-scheme covers.

Table 1: Summary of the CAISAR project targeted area

No.	Sub-Schemes	Provinces	Districts	Communes
1	Ou Ta Pong	Pursat	Bakan	1. Beung Khnar 2. Ou Ta Paong 3. Rumlech 4. Svay Doun Keo 5. Me Teok 6. Khnar Torteung
2	Lum Hach	Kampong Chhnang	Toek Phus	1. Krang Skear
			Rolea B'ear	2. Banteay Preal 3. Krang Leav 4. Prasneob
			Boribour	1. Anchanh Rung
3	Brambei Mom	Kampong Speu	Thpong	1. Brambei Mom 2. Rung Reung
4	Krapeu Troum	Kampong Speu	Odoung Maechey	1. Veal Pong
		Kampong Chhnang	Sameakki Meanchey	1. Thbeng Khpos 2. Svay
5	Yotasas	Kampong Chhnang	Sameakki Meanchey	1. Svay

6	Steung Krang Bat	Kampong Chhnang	Kampong Tralach	1. Longvek
		Kandal	Ponnhea Leu	2. Kampon Leung

With a coverage of 22,051 ha, CAISAR is expected to provide support to an estimated 22,500 people who do farming in the six sub-scheme area (See table below).

Table 2: List of six sub-schemes under CAISAR

No.	Scheme Name	Component 2						Beneficiaries	
		Irrigation		Rainfed area		Total			
		Area (ha)	Ratio (%)	Area (ha)	Ratio (%)	Area (ha)	Ratio (%)	HH	Ratio
1	Ou Ta Paong	14,874	67%	1,200	16%	16,074	55	15,000	67%
2	Lum Hach	3,900	18%	2,400	32%	6,300	21	3,900	18%
3	Krapeu Truom	690	3%	400	5%	1,090	4	1,100	3%
4	Yutasas	593	3%	600	8%	1,193	4	700	3%
5	Stoeung Krang Bat	994	5%	400	5%	1,394	5	650	5%
6	Brambei Mom	1,000	5%	2,400	32%	3,400	12	1,050	5%
Total		**22,051**	**100%**	**8,600**	**100%**	**34,204**	**100**	**22,500**	**100%**

1.3 Applicable Standards

Following a framework for effective project development as well as environmental sustainability, MOWRAM shall observe the national legal framework and protocols ratified by the Kingdom of Cambodia. For CAISAR Project, the following laws, regulations and guidelines are relevant:

1.3.1 The Constitution of the Kingdom of Cambodia (1993)

The Constitution is the highest legal authority in Cambodia and establishes the fundamental rights and duties of citizens and the state. It sets the groundwork for environmental protection, governance, social inclusion, and public well-being, ensuring that environmental and social rights are integrated into national laws.

- **Legal Framework on the Management and Conservation of Natural Resources and Biodiversity**
  - Law on Environmental Protection and Natural Resource Management (1996)
  - Environmental and Natural Resources Code 2023
  - Law on Land Management, Urban Planning and Construction (1994
  - Law on Water Resource Management (2007)
  - Law on Fisheries (2006)
  - Protected Areas Law (2008)
  - Land Law (2001)
  - Sub-Decree on Water Pollution Control (1999)
  - Sub-Decree on Environmental Impact Assessment (1999)
  - Sub-Decree on Air Pollution Control and Sound Disturbance (2000)
  - Sub-Decree on Solid Waste Management (1999)

- Prakas on Environmental Impact Assessment Reports (1999)
- Prakas on Hazardous Substances (2015)

- **Legal Framework on Labor, Public Well-Being, and Safety**
  - Labor Law (1997)
  - Law on Roads (2014)
  - Law on Road Traffic (2014)
  - Law on Suppression of Human Trafficking and Sexual Exploitation (2008)

- **Legal Framework on Governance and Social Inclusion**
  - Law on Taxation (1997)
  - Sub-Decree on Construction Permit (1993)
  - Law on Protection of the Rights of Persons with Disabilities (2009)
  - Law on Social Security Schemes (2002)
  - Sub-Decree on Health Care Scheme (2016)
  - Law on the Protection of Cultural Heritage (1996)
  - Expropriation Law (2010)
  - Sub-Decree on Land Acquisition and Resettlement (2018)
  - Sub-Decree on Social Land Concession (2003)
  - Sub-Decree on State Land Management (2005)
  - Sub-Decree on River Basin Management (2015)

1.3.2 AIIB'S Environmental and Social Framework (ESF)

The Environmental and Social Framework (ESF) of the AIIB outlines the principles and standards to ensure environmentally and socially sustainable development practices for projects it finances. The following AIIB's Environmental and Social Framework (ESF) apply to CAISAR.

- Environmental and Social Standard 1: Environmental and Social Assessment and Management
- Environmental and Social Standard 2: Land Acquisition and Involuntary Resettlement
- Environmental and Social Standard 3: Indigenous Peoples

1.3.3 IFADs' SECAP

The International Fund for Agricultural Development's (IFAD) Social, Environmental, and Climate Assessment Procedures (SECAP) provide a framework to ensure that IFAD-financed projects are sustainable, socially inclusive, and environmentally sound. The following Standards apply to CAISAR:

- Standard 1: Biodiversity Conservation
- Standard 2: Resource Efficiency and Pollution Prevention
- Standard 3: Cultural Heritage
- Standard 4: Indigenous Peoples
- Standard 5: Labor and Working Conditions
- Standard 6: Community Health and Safety

- Standard 7: Physical and Economic Resettlement
- Standard 9: Climate Change

1.3.4 GEF'S Environmental and Social Safeguards Policies

GEF adopts the interim environmental and social safeguards to identify, measure, and mitigate environmental and social risks based on IFC Performance Standards (PS). Under CAISAR, the following PSs are applied:

- Performance Standard 1 – Assessment and Management of Environmental and Social Risks and Impacts;
- Performance Standard 2 – Labor and Working Conditions
- Performance Standard 3 – Resource Efficiency and Pollution Prevention
- Performance Standard 4 – Community Health, Safety, and Security
- Performance Standard 5 – Land Acquisition and Involuntary Resettlement
- Performance Standard 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 7 – Indigenous Peoples
- Performance Standard 8 – Cultural Heritage

1.3.5 International Conventions and Treaties

Cambodia has ratified all eight of the International Labor Organisation (ILO)'s conventions which cover core labour standards recognized as human rights. These conventions focus on issues such as freedom of association, elimination of forced labour, abolition of child labour, and elimination of discrimination in employment.

- Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)
- Right to Organise and Collective Bargaining Convention, 1949 (No. 98)
- Forced Labour Convention, 1930 (No. 29)
- Abolition of Forced Labour Convention, 1957 (No. 105)
- Minimum Age Convention, 1973 (No. 138)
- Worst Forms of Child Labour Convention, 1999 (No. 182)
- Equal Remuneration Convention, 1951 (No. 100)
- Discrimination (Employment and Occupation) Convention, 1958 (No. 111)
- Employment Policy Convention, 1964 (No. 122)
- Weekly Rest (Industry) Convention, 1921 (No. 14)
- Labour Inspection Convention, 1947 (No. 81)
- Labour Inspection (Agriculture) Convention, 1969 (No. 129)
- Tripartite Consultation (International Labour Standards) Convention, 1976 (No. 144)

Overall, the Royal Government of Cambodia (RGC) has established various legal documents ranging from royal decrees, sub-decrees, and circulars framing the management, and implementation of all types of development projects and activities within the country at the pre-construction, construction and implementation periods. The laws cover the management and

protection of the natural resources, and biodiversity including underground, inland and water bodies. These legal frameworks also contain the standards that are applicable to the country context including water quality, soil quality, air, noise quality and vibration. Regarding human well-being including health, safety, labour and sexual exploitation, the country has made significant progress over the past years promoting the working environment of workers and labour forces embracing various laws and policies for ensuring the well-being of workers as well as the compliances that employers must comply. Laws to protect sexual exploitation, and social protection guarded the public, especially the vulnerable including the poor, and people with disability. Although the country's legal frameworks cover the requirements, there are still limited report in terms of actual enforcement which need to be taken care where a proper implementation plan and resources are needed.

2. BASELINE CONDITIONS

2.1 Environmental Conditions

2.1.1 Ambient Air quality, Noise and Vibration

- *Air Quality*

- **Ou Ta Paong**

At provincial level, the air pollution level is considered moderate[1]. The AQI is 58, which is equivalent to 13.1 µg/m^3. The ambient air quality, noise, and vibration is being linked to increases in industrial development, and the rapid urbanization. However, the Ou Ta Paong sub-scheme is in the rural settings and about 35km from the major population centers and industrial areas in Pursat town. The baseline ambient air quality, noise and vibration in Ou Ta Paong scheme is considered generally good. Ambient air quality is sometime affected by dust from tillage and unpaved road users, including smoke from burning of rice stubble after harvest. Whilst noise and vibration disturbance are sometime affected by motorist. However, the impacts are minor and short time.

- **Lum Hach**

At provincial level, the air pollution level is considered moderate[2]. The AQI is 58, which is equivalent to 12.8 µg/m^3. The Lum Hach scheme is located in the rural settings and about 60km from the major population centers and industrial areas in Kampong Chhnang town. The baseline ambient air quality, noise and vibration in Lum Hach scheme is considered generally good. Ambient air quality is sometime affected by dust from tillage and unpaved road users, including smoke from burning of rice stubble after harvest and burning from swidden cultivation activities.

[1] https://www.iqair.com/cambodia/pursat, accessed on 23rd September 2024

[2] https://www.iqair.com/cambodia/pursat, accessed on 23rd September 2024.

Whilst noise and vibration disturbance are sometime affected by motorist. However, the impacts are minor and short time.

- **Stung Krang Ponley**

Stung Krang Ponly located in two provinces – Kampong Chhnang and Kampong Speu. At provincial level, the air pollution level in Kampong Chhnang province is considered moderate. The air pollution level in Kampong Speu province also consider moderate. The AQI is 58[3], which is equivalent to 12.7 µg/m^3. The Stung Krang Ponly is in the rural settings; therefore, the baseline ambient air quality, noise and vibration is considered generally good. Ambient air quality is sometime affected by dust from tillage and unpaved road users, including smoke from burning of rice stubble after harvest and burning from swidden cultivation activities. Whilst noise and vibration disturbance are sometime affected by motorist. However, the impacts are minor and short time.

2.1.2 Noise and Vibration

Noise and vibration at the project locations in each sub-scheme are currently affected mainly by the commuters mainly along the roads within the areas which can be either the national or local road. As they are subjected to change over time, the testing of noise and vibration are required to be conducted right before the beginning of the construction.

2.1.3 Soil Quality

The soil quality study for this project took soil samples from five agricultural locations across different schemes in the region. The Ou Ta Paong sub-scheme was represented by two sites (SS.01 & SS.02), one for Lum Hach (SS.03) and two (SS.04 & SS.05) for Stung Krang Ponley. The analysis results, presented in the table below, provide valuable insights into the physical, chemical, and biological properties of the soils at these locations, which can inform agricultural management practices and decision-making.

Table 3: Soil analysis results in an agricultural context

No.	Description Parameter		Result				
			SS.01	SS.02	SS.03	SS.04	SS.05
1	Particle Size (Pipette Method)	(<0.002mm), Clay %	9.90	14.01	1.23	14.95	7.30
		(0.002-0.02 mm), Fine Silt, %	37.65	35.55	3.40	30.00	21.10
		(0.02-0.05 mm), Coase Silt, %	21.71	22.69	5.23	19.81	11.70
		(0.05-0.2 mm), Fine Sand, %	30.59	32.75	33.52	31.12	30.29
		(0.2-2 mm), Coase Sand, %	3.22	2.32	55.72	5.92	28.78
2	Ninnu Moisture %, (Oven dry at 105 °C and 24 hours)		1.67	1.73	0.20	2.64	2.62

[3] https://www.iqair.com/cambodia/kampong-speu, accessed on 23rd September 2024.

No.	Description Parameter		Result				
			SS.01	SS.02	SS.03	SS.04	SS.05
3	Total Carbon (Black & Walkey Method), C%		2.22	1.84	1.80	1.63	1.87
4	Total Nitrogen (Kjeldal Sulfuric Method),N%		0.19	0.17	0.17	0.14	0.17
5	C/N Ratio (Unit)		12	11	11	12	11
6	Organic Matter (0M)%		3.82	3.16	3.10	2.80	3.22
7	Total Phosphorus (Nitric Digestion) P %		0.051	0.043	0.046	0.044	0.094
8	Available Phosphorus (Bray II), P (ppm)		51	41	46	29	37
9	Cation Exchange Capacity C.E.C meq/100g Soil (Method,1M Ammonium Acetate at pH=7 & Leach with 10% NaCl)		13.00	12.40	10.00	16.50	16.30
10	Exchangeable Cation (meq/100g Soil), (Method, IM Ammonium Acetateat H=7)	Calcium (Ca)	3.06	3.77	3.56	8.30	5.43
		Magnesium (Mg)	1.28	1.38	1.58	2.37	1.48
		Sodium (Na)	1.42	0.75	0.30	2.57	1.50
		Potasium (K)	0.77	0.27	0.13	0.36	0.35
	Total Exchangeable Bases (meq/100g soil)		6.53	6.17	5.57	13.60	8.76
11	Bass Saturation %		50	50	56	70	54
12	Exchange Acidity meq/100g Soil, (1 M KCl Method)		20.00	15.00	5.00	10.00	10.00
13	Exchange Al meq/100g Soll, (1 M KCl Method)		0.20	0.12	0.04	0.12	0.12
14	Electrode Conductivity µS/cm, (1:5 Soil: water)		96.80	36.10	99.30	108.40	63.00
15	pH H2O (1:5 Soil: water)		5.36	5.29	7.67	7.41	5.66
16	pl KCL (1:5 (Soil: IN KCL)		4.21	4.12	6.51	6.23	4.47

(Source: Laboratory of the General Directorate of Agriculture, MAFF, 2024)

The soil characteristics of three areas—Ou Ta Paong, Lum Hach, and Stung Krang Ponley—were analyzed for their agricultural suitability.

- **Ou Ta Paong** has loam soil, ideal for agriculture due to its balance of sand, silt, and clay, with moderate organic matter and slightly acidic pH (4.12 to 5.36). However, low nitrogen and potassium levels may need supplementation for optimal crop growth.
- **Lum Hach** is classified as sandy loam, with a higher sand content that improves drainage but reduces water retention. The soil is slightly acidic (pH 6.51-7.67) with low nitrogen and potassium, which may limit crop yields. The organic matter content is moderate, supporting soil health, but nutrient and irrigation management is necessary due to sandy texture.
- **Stung Krang Ponley** soils are also sandy loam, with similar challenges of low water retention due to the high sand content. The pH ranges from slightly acidic to neutral (4.47-7.41), and nutrient analysis shows low nitrogen and potassium levels. Despite these limitations, the soil is generally suitable for agriculture with careful nutrient and water management.

Overall, all three areas show potential for agriculture, but improvements in nitrogen, potassium, and organic matter, along with proper irrigation, are necessary for sustained productivity.

2.1.4 Surface Water Quality

Water quality does not seem to be a critical issue for surface water, but the overuse of fertilizers and domestic wastewater are important threads. It is known to be a black market of all sorts of fertilizers, pesticides, insecticides, rodenticides, etc. sold at the borders with Viet Nam and applied indiscriminately by farmers to increase the numbers of crops a year[4]. Sub-Degree 103 on Water Pollution Control of Ministry of Environment (MoE) in 2021 with the purpose of regulating water pollution to prevent and reduce water pollution of public water areas so that the protection of human health and the conservation of biodiversity can be ensured. The collected water samples were measured at the premises as well as at the laboratory, commissioned by Innovation Lab which is partner of Royal University of Phnom Penh (RUPP).

- *Ou Ta Paong*

The water quality data of Ou Ta Paong compared to the Ministry of Environment (MoE) standards reveals several concerns. Key parameters such as arsenic, cadmium, lead, pH, total dissolved solids, and electrical conductivity are within acceptable limits, meeting the MoE standards for rivers and lakes/reservoirs. However, total nitrogen, total phosphorus, and total coliform levels exceed the standard limits, with nitrogen levels (3.5-4.8 mg/l) surpassing the river and lake limits (<3 and <2 mg/l, respectively), and total phosphorus (0.4-0.8 mg/l) significantly higher than the allowed levels (<0.25 and <0.15 mg/l). Additionally, total coliform levels are alarmingly high, far exceeding the permissible limit of 1000 CFU/100mL. Dissolved oxygen levels are adequate, remaining above the minimum requirement (>3 and >4 mg/l). These results indicate potential nutrient pollution and microbial contamination in the water.

- *Lum Hach*

The water quality data of Lum Hach, when compared to the Ministry of Environment (MoE) standards, shows compliance in several parameters but also some significant deviations. Parameters such as arsenic, cadmium, lead, total dissolved solids, electrical conductivity, temperature, and dissolved oxygen meet the required standards for both river and lake environments. However, the total nitrogen level (6.8 mg/l) is well above the MoE standards for rivers and lakes (<3 and <2 mg/l), and total phosphorus (0.6 mg/l) also exceeds the permissible limits (<0.25 and <0.15 mg/l). Additionally, total coliform levels are extremely high (19,100 CFU/100mL), far surpassing the allowed limit of 1000 CFU/100mL, indicating severe microbial contamination. The pH is slightly below the standard range, suggesting slightly acidic conditions. These results suggest nutrient pollution and microbial contamination in Lum Hach, posing environmental and health concerns.

- *Stung Krang Ponley*

The water quality data for Stung Krang Ponley shows that while some parameters are within acceptable limits set by the Ministry of Environment (MoE), several issues are evident. Parameters such as arsenic, lead, total dissolved solids, electrical conductivity, temperature, and

[4] The sustainable rice platform, supported by MAFF, is working towards controlling this market and training farmers on proper use (products' labels are not translated to Khmer). https://sustainablerice.org

dissolved oxygen meet the MoE standards. However, the cadmium concentration at SW8 (0.009 mg/l) exceeds the standard limit of <0.003 mg/l. The total nitrogen levels are particularly high across most sampling points (4.7 to 18.1 mg/l), significantly exceeding the limits. Total phosphorus is also elevated at SW6 (0.9 mg/l) and SW7 (0.7 mg/l), far above the permissible levels (<0.25 and <0.15 mg/l). Furthermore, total coliform levels are alarmingly high at all sampling points. These results suggest substantial nutrient pollution and microbial contamination, especially concerning for health and environmental safety.

Summary of the water quality testing is provided in Table below:

Table 4: Result of surface water quality

No	Parameter	Unit	Ou Ta Paong			Lum Hach		Stung Krang Bat	Yutas as	Krapeu Truom	Brambei Mom	Standard (MoE)	
			SW1	SW2	SW3	SW4	SWS1[5]	SW5	SW6	SW7	SW8	River	Lake and reservoir
1	Arsenic	mg/l	0.005	0.005	0.005	0.005	0.18	0.005	0.005	0.005	0.005	<0.01	<0.01
2	Cadmium	mg/l	0.001	0.001	0.001	0.001	ND	0.001	0.001	0.001	0.009	<0.003	<0.003
3	Lead	mg/l	0.005	0.005	0.005	0.005	ND	0.005	0.005	0.005	0.005	<0.01	<0.01
4	pH	-	6.32	6.2	6.44	6.42	7.58	6.78	6.91	6.53	7.49	6.5-8.5	6.5-8.5
5	Total dissolved solids	mg/l	30.76	38.07	40.71	14.95	18	71.07	91.58	83.43	99.21	<1000	<1000
6	Total suspended solids	mg/l	11	29	39	5	2	17	43	93	21	<100	<100
7	Total Nitrogen	mg/l	4.8	3.8	3.5	6.8	2.90	18.1	17.7	4.7	5.1	<3	<2
8	Total Phosphorus	mg/l	0.8	0.6	0.4	0.6	0.11	0.3	0.9	0.7	0.3	<0.25	<0.15
9	Total coliform	CFU/100mL	50,200	38,750	31,650	19,100	430	85,000	157,500	92,500	82,850	<1000	<1000
10	Electrical conductivity	µs/cm	61.4	76.12	81.43	29.91	-	138.7	183.4	167.1	197,1	500-1500	500-1500
11	Temperature	^{0}C	31.3	30.8	30.9	31.7	-	32.8	33.4	33.7	38.7	<45	<45
12	Dissolved oxygen	mg/l	5.34	5.6	5.7	5.21	7.70	5.62	5.65	6.84	5.4	>3	>4

(Source: Water Innovation Lab, 2024)

[5] Laboratory of Ministry of Environment 2024.

2.1.5 Groundwater Quality

Groundwater quality was collected from various locations within the project sites. Water testing is used to determine the existing groundwater quality at the project sites before construction and operation. The selected samples were analysed and the results of the testing both at the field and at laboratory is provided in Table 13 below.

Table 5: Result of groundwater quality

No	Parameter	Unit	Results			CDWQS
			GW1	GW2	GW3	
1	Arsenic	mg/l	0.005	0.005	0.005	0.05
2	Cadmium	mg/l	0.003	0.001	0.001	0.003
3	Lead	mg/l	0.0004	0.005	0.005	0.01
4	pH	-	**6.01**	**6.5**	**6.48**	6.5-8.8
5	Total dissolved solids	mg/l	345.8	58.12	325.5	800
6	Total suspended solids	mg/l	13	5	3	-
7	Total Nitrogen	mg/l	6.4	3.5	21.5	-
8	Total Phosphorus	mg/l	0.3	0.29	2.2	-
9	Total coliform	CFU/ 100mL	14,065	1,600	1,200	0
10	Electrical conductivity	µs/cm	691.4	116.1	651.6	-
11	Temperature	^{0}C	30.4	30.3	30.5	-
12	Dissolved oxygen	mg/l	1.92	1.45	1.25	-

(Source: Water Innovation Lab, 2024)

Test results show that almost all parameters are below Cambodia's drinking water quality standards of the Ministry of Industry, Science, Technology, and Innovation (MISTI) in 2004, except pH parameters are below the standard range and the total coliform exceeds the standard. Total coliforms are a common group of related bacteria found in soil, vegetation, and water. Boiling or filtering groundwater before drinking is required. Overall, the quality of groundwater in the project sites are safe for daily use, such as cooking, bathing, as well as laundry but not for drinking.

2.2 Biodiversity Conditions

2.2.1 Existing Species

A comprehensive biodiversity assessment included the utilization of the Integrated Biodiversity Assessment Tool (IBAT) and a literature review. The coordinates of this command area (via KMZ file) are used to inform the IBAT radius of screening, giving the default radius of IBAT screening between 20 to 50km depending on species ecological requirement and movement ranges. Steps to narrow down to the sub-scheme's area of influence were conducted to identify only EN and CR species that are potentially present in the sub-scheme area of influence. The final results were used to consult with experts at national level, identified a total of 25 endangered and critically endangered species across reptiles, mammals, birds, fish, amphibians, plants, and fungi. Sixteen of these species were concentrated in the Ou Tapong (OT) sub-scheme, while five were screened in Lum Hach (LC), two in Prambei Mom (BM) and Krapeu Truom (KT), and five in Yutasas (YT) and Stung Krang Bat (SKB) (Table 14).

Table 6: Second screening list of Endangered and Critically Endangered Birds, Mammals, Reptile and Fishes

No.	Local Name	English Name	Scientific Name	IUCN Category	OTP	LH	BM	KT	Yotasas	SKB
	Reptile spices									
1	អណ្តើកព្រេច	Elongated Tortoise	*Indotestudo elongata*	CR					Yes	
2	កន្ធាយក្បាលកង្កែប	Asian giant softshell turtle	*Pelochelys cantorii*	CR						
3	អណ្តើកក្អែក	Black Marsh Turtle	*Siebenrockiella crassicollis*	EN	Yes		Yes			Yes
4	អណ្តើកសោម	Giant Asian Pond Turtle	*Heosemys grandis*	CR	Yes					
5	អណ្តើកបិទមុខ	Southeast Asian Box Turtle	*Cuora amboinensis*	EN	Yes					Yes
	Mammal species									
6	តេរោមច្រមុះ	Hairy-nosed Otter	*Lutra sumatrana*	EN	Yes					
7	ស្វាព្រាម	Indochinese Silvered Langur	*Trachypithecus germaini*	EN	Yes					
8	ស្វាក្តាម	Long-tailed Macaque	*Macaca fascicularis*	EN	Yes					
9	ឆ្កែព្រៃ	Dhole	*Cuon alpinus*	EN		Yes				
10	ជ្រៀងធំ	Large Flying-fox	*Pteropus vampyrus*	EN		Yes				
	Fish species									
11	ត្រីត្រសក់ក្រហម	Jullien's Golden Carp	*Probarbus jullieni*	CR				Yes	Yes	
12	ត្រីចង្វាស្នឹង	Leaping barb/Flying Minnow	*Laubuka caeruleostigmata*	EN				Yes	Yes	
13	ត្រីប្រាធំ	Striped catfish	*Pangasianodon hypophthalmus*	EN	Yes		Yes			Yes
14	ត្រីការហោ /ត្រីគុលរាំង	Mekong giant barb/Giant Carp	*Catlocarpio siamensis*	CR					Yes	Yes
15	ត្រីកន្ត្រៃប់ខ្លា	Siamese Tiger Perch	*Datnioides pulcher*	CR	Yes	Yes				Yes
	Bird species									
16	ត្រដក់ធំ	Greater Adjutant	*Leptoptilos dubius*	EN	Yes					
17	រនៀលស	Milky Stork	*Mycteria cinerea*	EN	Yes					
18	ចាបព្រៃវែង	Yellow-breasted Bunting	*Emberiza aureola*	CR	Yes					
19	ខ្សឹប ឬ ទ្រមាក់អណ្តើក	Bengal Florican	*Houbaropsis bengalensi*	CR	Yes					
20	ក្ងោក	Green Peafowl	*Pavo muticus*	EN		Yes				
21	ពពូលទឹក	Masked Finfoot	*Heliopais personatus*	CR	Yes					
22	ទាព្រៃស្លាបស	White-winged Duck	*Asarcornis scutulata*	EN	Yes				Yes	
	Fungi, amphibians, and aquatic plants									
23	ផ្សិតកែវ	Puffball mushrooms	Calostoma insigne	EN		Yes				
24	កញ្ជាញ់ចេកភ្នំក្រវាញ	Cardamon Shrub Frog	*Philautus cardamonus*	EN	Yes					
25	ស្មៅស្នឹង / ទន្លេ	River-weed	*Terniopsis chanthaburiensis*	EN	Yes					

2.2.2 EN and CR Species Confirmation

- ***Ou Ta Paong***

The biodiversity assessment at Ou Ta Paong focused on confirming the presence of endangered (EN) and critically endangered (CR) species through observations and key informant interviews. The findings highlight significant ecological importance and potential for conservation in the region.

- **Reptile Species**: Four turtle and tortoise species were observed within and around the Ou Ta Paong Command Area. The *Black Marsh Turtle* was found in both the upper and lower sections, while the *Elongated Tortoise* was limited to the upper reaches. The *Giant Asian Pond Turtle* and *Southeast Asian Box Turtle* were only seen in the lower section near Tonle Sap Zone 3.
- **Mammal Species**: No sightings of three mammal species were confirmed in the upper section of Ou Ta Paong, but two primate species were observed in the lower section, including the *Indochinese Silvered Langur*, regularly seen in the flooded forests of Tonle Sap Zone 3. Reports also confirmed the presence of *Long-tailed Macaques* in the same area. Additionally, sightings of *Hairy-nosed Otters* were noted in deep waters near the Tonle Sap Great Lake.
- **Fish Species**: Key informants confirmed sightings of *Siamese Tiger Perch* in Boeng Kansaeng Lake, located in the southwest part of Ou Ta Paong. Encounters were reported in 2023-2024, with one informant having last seen the species 20 years ago. *Striped Catfish* were reported by one informant, who recalled seeing them during a major flood seven years ago. These species migrate to specific areas when the region is submerged.
- **Bird Species**: Informants reported sightings of critically endangered bird species, including the *Bengal Florican*, with recent observations in the lower section of Ou Ta Paong. The area provides suitable habitats such as wetlands, grasslands, and paddy fields, contributing to the species' potential survival. The *Greater Adjutant* was also confirmed, with reports indicating its presence in the region, although it may have migrated to Prek Toal Ramsar Site. Further monitoring and research are necessary to understand its population status. Informants struggled to differentiate between the *Milky Stork* and *Painted Stork*, a common challenge in bird identification, but it was noted that sightings of larger groups of Milky Storks were likely due to misidentification. The *Yellow-breasted Bunting* was reported as a winter visitor, although no locals could confirm sightings. It was identified as a potential species in the area due to its preference for lowland rice fields and marshes. Confusion was also reported with the *Wild-winged Duck*, which was mistakenly identified as the *Knob-billed Duck*, with no actual sightings confirmed.

Table 7: List of endangered and critically endangered species based on the IBAT Screening result vs. key informant interview at Ou Tapaong Command Area

No.	Local Name	English Name	Scientific Name	IUCN Cate	Screened Species	Confirmed Species
	I. Reptile spices					
1	អណ្តើកភ្នែក	Black Marsh Turtle	*Siebenrockiella crassicollis*	EN	Yes	Yes
2	អណ្តើកសោម	Giant Asian Pond Turtle	*Heosemys grandis*	CR	Yes	Yes
3	អណ្តើកបិទមុខ	Southeast Asian Box Turtle	*Cuora amboinensis*	EN	Yes	Yes
4	អណ្តើកព្រេច	Elongated Tortoise	*Indotestudo elongata*	CR	No	Yes
	II. Mammal species					
5	កេរោមច្រមុះ	Hairy-nosed Otter	*Lutra sumatrana*	EN	Yes	No
6	ស្វាព្រាម	Indochinese Silvered Langur	*Trachypithecus germaini*	EN	Yes	Yes
7	ស្វាក្តាម	Long-tailed Macaque	*Macaca fascicularis*	EN	Yes	Yes
	III. Fish species					
8	ត្រីប្រាជំ	Striped catfish	*Pangasianodon hypophthalmus*	EN	Yes	No
9	ត្រីកន្ត្រៃប់ខ្លា	Siamese Tiger Perch	*Datnioides pulcher*	CR	Yes	No
	IV. Bird species					
10	ត្រដក់ធំ	Greater Adjutant	*Leptoptilos dubius*	EN	Yes	Yes
11	រនៀលស	Milky Stork	*Mycteria cinerea*	EN	Yes	Yes
12	ចាបព្រៃវែង	Yellow-breasted Bunting	*Emberiza aureola*	CR	Yes	No
13	ខ្សឹប ឬ ទ្រមាក់អណ្តើក	Bengal Florican	*Houbaropsis bengalensi*	CR	Yes	Yes
14	ពពូលទឹក	Masked Finfoot	*Heliopais personatus*	CR	Yes	No
15	ទាព្រៃស្លាបស	White-winged Duck	*Asarcornis scutulata*	EN	Yes	No
	V. Amphibians, and aquatic plants					
16	កញ្ជាញ់ចេក ភ្នំក្រវៀញ	Cardamon Shrub Frog	*Philautus cardamonus*	EN	Yes	No
17	ស្មៅស្ទឹង / ទន្លេ	River-weed	*Terniopsis chanthaburiensis*	EN	Yes	No

- ***Lum Hach***

The biodiversity assessment at Lum Hach Irrigation Sub-scheme employed the Integrated Biodiversity Assessment Tool (IBAT) and key informant interviews to screen for endangered (EN) and critically endangered (CR) species in the area. The assessment identified the following species:

- Mammal Species: *Dhole (Cuon alpinus)* – Despite initial screenings, no confirmed sightings of the dhole were made within the study area. This absence may be attributed to factors such as habitat fragmentation, human disturbance, or low

population densities.
Flying-fox (Pteropus vampyrus) – Similarly, no flying-foxes were confirmed in the study area. Their absence could be due to habitat loss, hunting pressure, or other environmental stressors affecting their population.

- Fish: *Siamese Tiger Perch (Datnioides pulcher)* – This species was not observed in the study area, likely due to its preference for larger water bodies, such as the Tonle Sap Great Lake. Three key informants reported encountering this species when fishing at Tonle Sap annually, but none had observed it within the Lum Hach region.
- Birds: *Green Peafowl (Pavo muticus)* – Green Peafowl were found across all three community forests in the area, indicating their adaptability to the local environment and highlighting the critical role these habitats play in their conservation.
- Amphibians and Aquatic Plants: *Puffball Mushrooms (Calostoma insigne)* – Although not confirmed within the study area, there is potential for their presence in the higher elevations of the Cardamom Mountains, suggesting further exploration may be necessary to confirm their existence.

- ***Stung Krang Ponley***

The biodiversity assessments at the four sub-schemes (Brambei Mom, Krapeu Truom, Yutasas, and Stueng Kang Bat) in the Stoeung Krang Ponley River catchment system provide insights into the species distribution and ecological significance of the area, with key findings focused on reptiles and fish.

- **Brambei Mom**: Semi-structured interviews with fishermen at Brambei Mom and Anlong Chrey reservoirs revealed frequent misidentifications of species, with fishermen mistakenly identifying Mekong Giant Barb as Rohu. No confirmed sightings of Jullien's Golden Carp or Striped Catfish were reported, and no turtles were observed. Historical releases of fish during National Fisheries Day may explain the presence of Pangasianodon species, though their identity remains uncertain.
- **Krapeu Trom**: Interviews in the Krapeu Trom sub-scheme targeted the Jullien’s Golden Carp and Flying Minnow species. Only one informant reported a sighting of Jullien's Golden Carp in 2022 during a flooding event. The species appeared to have migrated upstream from the Tonle Sap but got trapped in the spillways, and it was suggested that a lack of flooding may affect fish populations.
- **Yutasas**: The Yutasas area supports several endangered species. Confirmations were made for Jullien's Golden Carp, Flying Minnow, and Mekong Giant Barb. A female fisher reported catching five Jullien’s Golden Carp during a flood, and two informants confirmed sightings of Flying Minnow in their ponds and the lower reservoir. Mekong Giant Barb were found in the reservoir after heavy rains, with informants indicating that the species were likely attempting to migrate upstream.
- **Stueng Krang Bat**: This sub-scheme was identified as hosting several endangered and critically endangered species, including the Black Marsh Turtle, Southeast Asian Box Turtle, Striped Catfish, Mekong Giant Barb, and Siamese Tiger Perch. Fishermen in the area consistently reported declining populations of Striped Catfish and Mekong Giant Barb. These fish species were noted to migrate from the Tonle Sap to the

floodplain, but catches have significantly decreased over the years. Reptile sightings were scarce, with only occasional encounters of the Black Marsh Turtle and Southeast Asian Box Turtle.

This assessment highlights the ecological importance of these sub-schemes, with several species facing population declines due to habitat changes and limited flooding events. Further conservation efforts are recommended to protect the vulnerable species confirmed in these areas.

Table 8: List of endangered and critically endangered species based on the IBAT Screening result vs. key informant interview at Stueng Krang Bat Sub-scheme

No.	Local Name	English Name	Scientific Name	IUCN Category	Screened Species	Confirmed Species
I.	**Reptile spices**					
1	កន្ធាយក្បាលកង្កែប	Asian giant softshell turtle	Pelochelys cantorii	CR	No	Yes
2	អណ្តើកក្អែក	Black Marsh Turtle	Siebenrockiella crassicollis	EN	Yes	Yes
3	អណ្តើកបិទមុខ	Southeast Asian Box Turtle	Cuora amboinensis	EN	Yes	Yes
III.	**Fish species**					
4	ត្រីប្រាំង	Striped catfish	Pangasianodon hypophthalmus	EN	Yes	Yes
5	ត្រីកាហោ /ត្រីគុលរាំង	Mekong Giant Barb	Catlocarpio siamensis	CR	Yes	Yes
6	ត្រីកន្ត្រៃប់ខ្លា	Siamese Tiger Perch	Datnioides pulcher	CR	Yes	Yes

2.3 Social Conditions

The project covers a large and distinctive areas in four provinces: Pursat, Kampong Chhnang, Kampong Speu and Kandal province. Ou Ta Paong and Lum Hach sub-schemes are administratively and geographically independent whereas Brambei Mom, Krapeu Truom, Yutasas and Stung Krang Bat are connected to each other as the sub-schemes share the same river basin and somehow have associated water sources. The sociological conditions of the sub-schemes are described in the following sections.

- ***Ou Ta Paong***

Ou Ta Pong command area is located solely in Bakan District, Pursat Province. The command area is approximately 16,074 hectares, comprising of cultivation area, residential, and non–residential areas (e.g. farm roads, other infrastructure works). The sub-scheme spans across parts of six communes in Bakan district including Boeung Khnar, Ou Ta Paong, Rumlech, Svay Don Keo, Me Teok, and Khnar Torteng. In total, there are 38 villages from these communes that are geographically located within the command areas, resulting from the verification with commune councils, the SECAP II team and overlaying of map between the administrative boundary of the communes and the command area. The total number of households within these 38 villages were reported at 8,130 HHs, given the total population of 34,189 people (out of which 17,602 are females).

Table 9: Administrative and population coverage of Ou Ta Paong sub-scheme

No.	Province/ District	Communes	Number of Villages	Total HH	Total Population	Female Population
1	Pursat/ Bakan	Beung Khnar	1	254	1040	516
		Ou Ta Paong	19	3,973	17,263	8,949
		Rumlech	1	263	960	503
		Svay Doun Keo	6	1,178	2,691	5,143
		Me Teok	8	2,176	4,385	8,686
		Khnar Torteung	3	286	1,097	558
	Total	**6**	**38**	**8,130**	**34,189**	**17,602**

(Source: Ministry of Planning, Commune Database, 2023)

- ***Lum Hach***

The updated gross command area of Lum Hach is estimated at approximately 3,900 ha situated within three districts of Kampong Chhnang province including Toek Phus, Rolea B'ear, and Boribour districts. The sub-scheme spans across five communes including Krang Skear commune, Toek Phus district, Banteay Preal, Krang Leav, and Praseob commune in Rolea B'ear district and Anchang Rong commune in Boribour district. In total, there are 36 villages from these communes that are geographically located within the command areas as the result of the verification with commune councils, the SECAP II team and overlaying of map between the administrative boundaries of the communes and the command area. The total number of households within these 36 villages in 2023 were reported at 7,958 HHs, given the total population of 30,844 people (out of which 16,019 are females).

Table 10: Administrative and population coverage of Lum Hach sub-scheme

No.	**Province/ District**	**Communes**	**Number of Villages**	**Total HH**	**Total Population**	**Female Population**
1	Kampong Chhnang / Toek Phus	Krang Skear	6	2,044	7,746	3,926
2	Kampong Chhnang / Rolea B'ear	Banteay Preal	10	1,301	4,929	2,568
		Krang Leav	8	1,729	6,647	3,528
		Prasneob	6	1,412	5,377	2,767
3	Kampong Chhnang / Boribour	Anchanh Rung	6	1,472	6,145	3,230
	Total	**5**	**36**	**7,958**	**30,844**	**16,019**

(Source: Ministry of Planning, Commune Database, 2023)

- ***Stung Krang Ponley***

The command areas of Stung Krang Ponley under the project is 3,277 ha, home to four sub-schemes of the project including Brambei Mom (1,000 ha), Krapeu Truom (700 ha), Yutasas (650 ha), and Steung Krang Bat (1,000 ha).

Administratively, the command areas located in three provinces including Kampong Chhnang, Kampong Speu, and Kandal span across the 7 communes of the three provinces, giving the total of 30 villages, giving the total households of 6,702 HHs with a total population of 28,163 people (out of which 14,612 are females). One commune, Svay Commune, Sameaki Meanchey district, Kampong Chhnang province, stretches across two sub-schemes: Krapeu Truom and Yutasas.

Table 11: Administrative and population coverage of Lum Hach sub-scheme

No.	Province/ District	Communes	Number of Villages	Total HH	Total Population	Female Population
	Brambei Mom					
1	Kampong Speu / Thpong	Brambei Mom	5	1,042	4,405	2,288
		Rung Reung	4	872	3,832	1,964
	Sub-Total	**2**	**9**	**1,914**	**8,237**	**4,252**
	Krapeu Trom					
1	Kampong Speu / Odoung Maechey	Veal Pong	8	932	4,165	2,201
2	Kampong Chhnang /Sameakki Meanchey	Thbeng Khpos	4	1,281	5,207	2,688
		Svay	1	217	1,163	594
	Sub-Total	**3**	**13**	**2,430**	**10,535**	**5,483**
	Yutasas					
1	Sameakki Meanchey (Kampong Chhnang)	Svay	5	1,339	5,330	2,773
	Sub-Total	**1**	**5**	**1,339**	**5,330**	**2,773**
	Steung Krang Bat					
1	Kandal/ Ponnhea Leu	Kampon Leung	1	369	1,653	856
2	Kampong Chhnang/ Kampong Tralach	Longvek	2	651	1,248	2,408
	Sub-Total	**2**	**3**	**1,020**	**4,061**	**2,104**
	Total	**7**	**31**	**6,703**	**28,163**	**14,612**

(Source: Ministry of Planning, Commune Database, 2023)

3. Environmental & Social Risks, Impacts and Mitigation Measures

3.1 Environmental and Climate Risks and Impacts

In this section, the E&S risks and impacts (that potentially arise during activity implementation and operationalization) are identified, analysed, and evaluated at project level — with regards to the nature, scope, scale, and the potential extent of activity impacts — through classification of such risks and impacts as direct, indirect, and cumulative. The assessment of E&S risks and impacts in this chapter is based on the following grounds that is fundamental to proposing measures to avoid, minimize, and mitigate for the impacts in the next chapter:

Project's original technical reports

- Feasibility Studies (August 2023)
- Feasibility Studies (updated by November 2023).
- Additional Pre–Feasibility for Ou Ta Pong Sub–scheme.
- Environmental and Social Management Framework – ESMF (Updated by October 2023)
- IBAT reports for project locations (Ou Ta Pong, Lum Hach and Stung Krang Ponley Irrigation Schemes)

Stakeholder Consultations (national, provincial, district, commune, and village levels)

- Community Meetings
- Focus Group Discussions
- Key Information Interview.

Field observation, using

- Transect walks.
- Drones (for E&S screening and biodiversity assessment)
- For detail information on Biodiversity Assessment, please refer to Biodiversity Impact Assessment Report

External technical reports

- Statistical reports/database.
- Publications and Technical Reports from national and internation institutions.

Table 12: Environmental Risks, Impacts and Mitigation Measures

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
BEFORE CONSTRUCTION					
UNEXPLODED ORDNANCES (UXO)					
Although effort have been made to demine across the country, mortar shells, aerial bombs, and other unexploded ordnance may be found within the subproject area. Some demining operations have been carried out at shallow depths, and UXO maps have been generated but it is not known if there is UXO that is located in proximity of the structures where structural upgrading would be made. Of particular concern is the hazard posed by unexploded ordinance left during the war, particularly in area where deep excavation is required.	Construction/ Rehabilitation of canals, farm roads, and relevant facilities that involve earthworks, soil excavation, river dreding, and so forth.	Residents, construction workers, animals, and any objectives nearby **High**	There have been no reported incidents of mines or unexploded ordnance (UXO) within the command areas. However, the risk remains due to the country's long history of civil war, with mine clearance efforts often limited to surface-level areas. As a result, construction activities involving deeper excavation could potentially expose mines or UXO, leading to explosion. This risk more likely to occur within the command area and at location where physical excavations are carried out.	Direct	- In case of finding any suspected objects during any work, UXO clearance procedure must be followed - UXO screening/assessment will need to be carried out by certified UXO experts before any physical/ construction activities, including mobilization of contractors to construction site, are allowed. - In case UXOs are found by certified experts during on-site screening, removal of UXO will be carried out by certified experts. - A UXO clearance certificate shall be obtained from related authority for each sub-project prior to commencing any subproject activities. - As part of site-specific ESCMP, conduct training and awareness activities for local community with regards to UXO risks and chance finds.
DURING CONSTRUCTION					
ENVIRONMENTAL POLLUTION					
• **Noise:** - Earthmoving activities and operation of machineries at construction sites will generate dusts and exhaust fumes.	Rehabilitation of irrigation canal and farm roads	• Nearby residents • Construction workers **Minor**	There are limited large scale and heavy infrastructure construction being planned in the project, except the construction of small-scale hydraulic structures of the irrigation system. In addition, the larger ones are normally located outside the residential areas	Direct	- Right before the construction, conduct noise testing at the sensitive locations as per the detail engineering design comparing to the IFC EHS Guideline - Avoid night-time construction in

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
- Construction activities, operation of vehicular movement, excavation machineries, concrete mixing, and other construction activities will generate noise and vibration and will be a nuisance to workers and residents near the site. - Noise may be generated from workers' camp, particularly during living activities or entertainment at nighttime, or due to certain maintenance /repair of equipment, machinery, vehicles.			whereas some small cross check structures are located within residential area, only in Ou Ta Paong and Lum Hach whereas the construction site at Stung Krang Ponley which are located mainly at the paddy field. They are unlikely to affect community people as the duration is short while the people along the national road in Krang Ponley scheme will be possibly heard the traffic noise along the road instead, making the noise from the construction will limitedly affect them. In addition, the scale of impact is at local level but there are likely some noises from transport vehicles of the construction as materials for construction are needed.		populated/village areas. - Minimize project transportation through community areas where possible. - Ensure proper maintenance and proper operation of construction machinery to minimize noise generation. - Where possible, maintain existing trees, bushes, vegetated areas, to prevent part of sound (that may be generated from construction site, vehicle, operating heavy equipment) from reaching nearby residential areas. - No noisy construction-related activities will be carried out from 21:00 hours to 06:00 hours along residential areas, hospitals, schools and during religious or cultural events near the subproject - All construction equipment and vehicles must be well maintained, regularly inspected for noise emissions, and shall be fitted with effective muffler and other appropriate noise suppression equipment consistent with applicable national and local regulations. - Use only vehicles and equipment that are registered and have necessary permits. Truck drivers and equipment operators should

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					avoid, as much as possible, the use of horns in densely populated areas and where there are other sensitive receptors found such as schools, temples, hospitals, etc. - Impose speed limits on construction vehicles to minimize noise emission along areas where sensitive receptors are located (houses, schools, temples, hospitals, etc. - Provide temporary noise barriers (3–5-meter-high barrier can reduce 5–10 dB(A)), as necessary, if site works will generate high noise levels that could disturb nearby households, hospital, school and other sensitive receptors. - Restrict use of vibrating rollers and operation of heavy equipment near sensitive structures.
• **Air pollution:** Dust will be generated by transportation of material, clearing, grading, excavation, levelling, truck hauling, stockpiling, waste disposal, access road rehabilitation. In addition, the emission is also expected from machineries and vehicles, especially during dry season	Transportation of materials, clearing, grading, excavation, levelling, truck hauling, stockpiling, waste disposal, access road rehabilitation	• Nearby residents • Construction workers **Minor**	• These activities generate dust and particulate matter (PM10 and PM2.5) from soil disturbances, stockpiles, and road works, leading to localized air pollution that can affect respiratory health. Exhaust emissions from trucks and heavy machinery release pollutants such as nitrogen oxides (NOx), carbon monoxide (CO), sulphur dioxide (SO2), and volatile organic compounds (VOCs), contributing to smog formation and greenhouse gas emissions. Additionally, waste disposal, particularly through burning, can	Direct	- Right before the construction, conduct ambient air quality testing at the sensitive locations as per the detail engineering design comparing to the IFC EHS Guideline - Spray or sprinkle water on work surfaces regularly in windy and dry weather, when necessary. - Avoid open burning of debris, cut vegetation (trees, undergrowth) or construction waste materials. - Reduce the operation hours of

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
			release harmful pollutants into the air, further degrading air quality. However, the level of generation is minimal as the extent of the release is gradually moved from place to place and short in duration.		generators, machines, equipment, and vehicles as much as possible and control vehicle speed. - Ensure regular maintenance of generators, machines, equipment, and vehicles used at project site. - To protect against dust and fumes, spray water onto the ground. - Construction equipment is maintained to a good standard and conduct immediate repairs of any malfunctioning construction vehicles and equipment. - Equipment and vehicles not in use should be switched off. - Machinery and vehicles causing excessive pollution (e.g., visible smoke) will be banned from construction sites. - All construction equipment and vehicles shall have valid certifications indicating compliance with vehicle emission standards. - The site of concrete mixing plants, crushing plants, quarries and other facilities that cause high dust and/or gaseous emissions should be at least 500 m from settlements and other sensitive receptors (schools, hospitals, etc.). - Tightly cover trucks transporting construction materials (sand, soil, cement, gravel, etc.) to avoid spills

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					and dust emission.
• **Water pollution** - Surface water quality reduction can occur due to construction, especially the earthwork, leakage of oils and chemical materials - Underground water quality reduction due to construction activities	Dredging and excavation activities, often required for the rehabilitation and upgrading of irrigation infrastructure in river systems	• Nearby residents • Construction workers **Moderate**	The dredging and excavation activities are required for all sub-schemes that can significantly impact water quality, particularly through increased sedimentation. Disturbed soil from excavation can enter water bodies, potentially polluting domestic water sources as sediment is carried downstream when water is released from rehabilitated reservoirs or canals. Large-scale dredging along Ou Ta Paong, spanning up to 30 km, may affect water quality throughout the excavation period and could extend to Tonle Sap Lake if proper mitigation measures are not in place. In addition, project activities can also impact groundwater quality, particularly through the infiltration of wastewater from workers' camps and the leakage of hazardous materials such as oil and diesel into water bodies, further contributing to water pollution.	Direct and indirect	- Construction diversion control should be prepared to avoid water flow, and spreading of all pollutants caused by the construction. - Do not fill up canals and creeks at the construction site. In case the filling of local drainage system is necessary, consultation with local authorities shall be undertaken and their permission obtained beforehand. - An alternative drainage should be established before the existing canal is filled up. - Prohibit placement of construction materials, waste storage areas or equipment in or near drainage channels and water courses. - Discharge of oily wastewater, fuel, hazardous substances and wastes, and untreated sewage to watercourses/canals and on the ground/soil is prohibited. - Provide adequate drainage at the construction sites and other project areas to avoid flooding of surrounding areas and minimize flow obstruction of existing watercourses. - Include in engineering drawing the construction of retaining structures such as gabion baskets, riprap, etc. for riverbank protection.

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					- Obtain required permits indicating water sources and permissible volumes - Maintain communication with local communities during construction stage to ensure that local water users provide timely feedback on water quality, if any, during construction process. - Conduct water quality testing from upstream and downstream of the river system for quality test during and after construction to compare with the baseline and the IFC standard for monitoring purposes.
• **Soil pollution/ quality reduction:** Leakage of oils, and chemicals used for machinery and construction process at farming land and construction sites	The activities affecting soil quality during this stage include dredging and the leakage of oils used for machinery and construction processes at construction sites.	• Nearby residents • Construction workers **Moderate**	Since excavation of the soil is at a large scale, the impact may be major. For example, oil leakage from construction equipment and large-scale soil excavation can significantly impact soil quality. Oil introduces harmful contaminants like hydrocarbons and heavy metals, reducing soil fertility, disrupting microbial activity, and posing risks to nearby water bodies through runoff. In addition, excavation disturbs soil structure, increasing erosion and reducing its ability to retain water and nutrients, which can decrease agricultural productivity.	Direct	- Scheduling construction activities during the dry season as much as possible. - Store fuels, oils, and chemicals safely in areas on an impermeable surface with proper containment berms. Spillage of oil and chemicals must be handled immediately to prevent infiltration. - Cover all restored areas with topsoil and re-vegetate (plant grass, fast-growing plants/trees) construction areas quickly once work is completed. - Construction diversion control should be prepared to avoid water flow, and spreading of all pollutants caused by the construction.

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
• **Solid waste:** During construction, waste of various kinds will be generated including solid wastes, hazardous wastes, and domestic solid waste (at workers' camp site). Solid waste may include surplus excavated materials, used lumber for trenching works, waste generated from demolition of existing camp, structures, construction debris, and so forth. This is added with the domestic waste such as food waste (bone, and meat waste and vegetables), paper, glass, metals, plastics, textiles, etc. being disposed by in-migrant labourers.	• Excavation and site clearing • Demolition of existing structures • Construction of temporary worker camps • Use of heavy machinery • Trenching works	• Nearby residents • Construction workers • Soil in the rivers and farmland **High**	The rehabilitation and upgrading construction for existing irrigation infrastructure in command areas often involves the establishment of temporary worker camps, the use of heavy machinery like trucks and excavators, and the generation of various types of waste. Solid waste generated during construction may include surplus excavated materials, used lumber from trenching works, debris from the demolition of existing camp structures, and other construction remnants. Domestic waste generated by construction workers at the construction site, worker camps, and other facilities can also contribute to environmental pollution. While the direct impact of this waste is often localized to the construction site and camps, improper management can lead to further environmental damage. Hazardous waste, such as oil and chemicals used in construction operations, can pose a threat to the environment. If not handled carefully, these hazardous materials can leak into the soil, causing contamination and potentially contaminating nearby water bodies.	Direct and Indirect	**For hazardous waste in agricultural production** - Crop residue: straw and stub should be collected for use as animal feed or for other purposes such as for mushroom growing, or for sale, or reuse for other farming purpose (e.g. incorporating into soil to improve soil fertility) - Empty pesticide containers: collected and kept appropriately as per recommendation in IPM good practices. - Never through and leave empty pesticide contain in the field which may contaminate soil and surface water which may affect aquatic animals and even humans. **For non-hazardous waste** - Reduce, recycle, and reuse waste [e.g. plastic waste, electronic waste, agricultural waste (natural, animal faces for later use as manure, plant waste)] wherever and whenever possible. - Latrines must be built at construction sites and camp sites for appropriate domestic waste management. **For dredging materials** - Use or reuse the dredge material on properties with a residential or recreational use (dredging material, if planned for reuse, will be subject

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					to testing to ensure the material is safe for reuse). - Prepare short-term placement of dredge material during off-loading or re- handling activities. The quantity of dredge material to be stored at the site must not exceed the quantity of material that can reasonably be managed at the site during the construction periods - Consult properly regarding the selection and design of the waste disposal locations and storage facilities - Dewatering the dredge material prior to reuse of the materials.
• **Wastewater:** - Hazardous wastewater, such as oil or fuel, chemical used for machinery and construction process at the construction site. - Domestic wastewater comes from workers/staff's water consumption daily.	• Use of heavy machinery and equipment (oil and fuel leaks, spills). • Construction processes (chemical spills, leaks). • Worker camp activities (discharge of domestic wastewater).	• Nearby residents • Construction workers • Water body along construction site **Moderate**	•	Direct	Segregate waste (e.g. hazardous and non-hazardous), collect, store and transport waste to designated waste disposal sites. **For hazardous waste in construction** - Setting up a systematic waste management and chain of custody system considering waste reduction at source, recycling, temporary storage, transport, and final disposal. - Develop procedures for the safe collection, storage, transport, and disposal of project hazardous waste at licensing/permitting site. - Never dispose of used oil on the ground and in water courses as it

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					can contaminate soil and groundwater (including drinking water supplies). - Have a diluted wash wastewater disposal ground tank with internal water proofing layer to protect leakage. - Store fuel and hazardous substances and wastes on bonded paved areas with roofs and interceptor traps so that accidental spills do not contaminate the environment. If spills or leaks do occur, undertake immediate clean up. - Train relevant construction personnel in handling of fuels and other hazardous substances as well as spill control and clean-up procedures. - Ensure availability of spill clean-up materials (i.e. absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are stored. - Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport and disposal shall not cause pollution and shall be undertaken consistent with national and local regulations. - Store waste oil, lubricant and other

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					hazardous materials and waste in tightly sealed containers to avoid contamination of soil and water resources. - Ensure all storage containers of hazardous substances and wastes are in good condition with proper labelling. - Regularly check containers for leakage and undertake necessary repair or replacement. - Store hazardous materials above flood level. - Storage areas for fuel, oil, lubricant, bitumen and other hazardous substances will be located at least 100 m away from any watercourses. - Storage, transport and disposal of hazardous wastes, including spilled wastes, shall be consistent with national and local regulations. - Wherever possible, refueling will be carried out at a fuel storage area. - Refueling shall not be permitted within or adjacent to watercourses. - Where a significant amount of oily wastewater or spill/leakage of oil and grease may occur (i.e. equipment maintenance areas), drainage leading to an oil- water separator shall be provided for treatment of wastewater. The oil-water separator shall be regularly skimmed of oil and maintained to

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					ensure efficiency. - Vehicle maintenance and refueling will be confined to designated areas in construction sites designed to contain spilled lubricants and fuel. - Adequate precautions will be taken to prevent oil/lubricant/hydrocarbon contamination of channel beds. Spillage if any will be immediately cleared with utmost caution to leave no traces. - All areas intended for storage of hazardous materials will be quarantined and provided with adequate facilities (i.e. firefighting equipment, sorbent pads, etc.) to combat emergency situations complying with all the applicable statutory stipulation. - For canal rehabilitation works, the project will have proper sludge handling and management procedures to manage the excavated sludge materials and to prevent harmful exposure to workers and surrounding communities.
BIODIVERSITY					
• **Habitat Loss and Fragmentation:** - Conversion of forests and wetlands at micro or large may be needed for canal construction such as Lum	Rehabilitation of irrigation canal and farm roads	Terrestrial species **Moderate**	Prior to construction, there will be clearance of micro forest along the rehabilitated streams, canals, and access road. Other activities such as river dredging and rehabilitation activities, as well as dam construction	Direct and indirect	Implement Biodiversity Action Plan Apply Find Chance Procedure

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
Hach community forestry leading to broken down of the habitat. - The remaining natural habitats may become isolated patches, making it difficult for species to migrate, find mates, and maintain healthy populations.			and upgrading, in the Ou Ta Paong, Lum Hach, and Stung Krang Bat schemes will be potentially led to habitat loss and fragmentation. Thes project involve altering the natural course of rivers and waterways, which can disrupt existing aquatic ecosystems. Dredging activities can remove valuable aquatic vegetation and disturb sediment beds, destroying habitats for fish and other aquatic organisms. The construction of dams can create barriers that isolate upstream and downstream populations, limiting their access to food and breeding grounds. Additionally, these projects can introduce pollutants and sedimentation into the water, further degrading habitat quality and impacting biodiversity. But these impacts are likely to be considered moderate due to biodiversity assessment, in that there is not rich of biodiversity hot spot and the surrounding area is mostly paddy fields.		
• **Loss of Biodiversity and ecosystem services** - Species Decline: Habitat loss and degradation can lead to declines in species populations in the long run, particularly those already classified as critically endangered. - Disruption of Ecosystem Services: The loss of biodiversity can disrupt ecosystem services such as water purification, flood control, and carbon storage, slightly contributing to the long-term impact.	Rehabilitation of irrigation canal and farm roads	Aquatic and terrestrial species **High**	While project activities in the construction phase like river dredging and canal rehabilitation can have some short-term impacts on fauna and flora, these effects are generally not considered serious. The interventions are primarily focused on restoring existing irrigation systems, and the affected areas are not known for high biodiversity. The noise from construction activities may temporarily disturb wildlife, but it is unlikely to cause long-term harm. The movement of aquatic biodiversity might be restricted due to the cut-off of waterways in certain sub-schemes. Overall, the fauna	Direct and indirect.	- Implement Biodiversity Action Plan - Apply Find Chance Procedure

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
			and flora effects of these projects are anticipated to be minimal and reversible. However, if the plan to construct the canal across community forestry in Lum Hach, there would be likely a significant change for wildlife in the areas.		
• **Hunting, trading, and consumption of wildlife** - The influx of a new labour force can increase demand for exotic local foods, including wildlife and endangered species, which are often seen as interesting and delicious. This may be done for relaxation or belief that wildlife is tasty or making people healthy.	Rehabilitation of irrigation canal and farm roads	Aquatic and terrestrial species/ **High**	The risks can be quite severe where there is a large workforce or where the local wildlife is rare and endangered. There is also a risk to the aquatic endangered species as well. This demand drives illegal hunting and trading, threatening biodiversity and destabilizing ecosystems. The rarity of these species raises their market value, encouraging unsustainable practices that can lead to extinction. Additionally, consuming wild animals poses health risks due to zoonotic diseases and can harm local economies by depleting valuable fish stocks, affecting communities reliant on these resources. It is likely to occur not only at the local level but at the regional level as well and the impact is severe and irreversible.	Direct and indirect, and short and long term	- Implement Biodiversity Action Plan
• **Loss of fauna and flora** - Construction activities, including the rehabilitation of irrigation canals and farm roads, can lead to the clearing of vegetation and the disruption of natural habitats. This is particularly concerning areas like the Lum Hach command area, where the project might involve constructing a canal across community forestry, potentially causing a significant change for wildlife. While the overall	Construction of canals and roads, especially across community forestry	Various species, particularly those dependent on forests and wetlands. **High**	Construction activities could lead to habitat loss and fragmentation, directly impacting fauna and flora. This impact could be significant in areas like Lum Hach, where the project might involve construction across community forestry. The construction of new canals and roads may require clear vegetation, leading to habitat loss and fragmentation. This is especially concerning given the presence of endangered and critically endangered	Direct	- Construction activities should avoid clearing vegetation outside the designated project area. Existing trees and vegetation should be protected. - Measures should be implemented to prevent sedimentation in water bodies and mitigate downstream impacts from erosion. - Construction waste should be properly managed to prevent soil

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
impact on fauna and flora is anticipated to be minimal and reversible in most areas, the specific location and scale of construction activities play a crucial role in determining the severity of the impact. For instance, noise from construction might temporarily disturb wildlife but is unlikely to cause lasting harm. However, the construction of dams and other structures could alter water flow patterns, affecting fish migration and potentially leading to population decline.			species, including the Elongated Tortoise, the Giant Asian Pond Turtle, and the Hairy-nosed Otter.		and water pollution. - Wildlife protection measures should be implemented, such as exclusion fencing and wildlife corridors. Additionally, construction activities should be avoided during sensitive periods for wildlife. - Environmental impacts should be regularly monitored, and the project must comply with environmental permits. - Apply Find Chance Procedure
• **Destruction of farming ecosystem** - The construction phase of the CAISAR project poses a serious threat to farming ecosystems due to soil compaction and pollution. Heavy machinery and construction activities can compact the soil, reducing its porosity and ability to retain water and nutrients, ultimately leading to decreased land productivity. Soil erosion from construction sites, exacerbated by the removal of vegetation and disruption of the landscape, can transport sediments and pollutants into nearby water sources, harming both crops and livestock. The risk of pollution from construction sites, specifically mentioning potential water contamination from sourcing aggregates and construction materials. These pollutants, along with runoff from construction sites carrying sediment, oil, and chemicals, can directly harm crops,	• Construction activities • Alteration of water regimes due to irrigation infrastructure (dams, levees) • Pollution from agricultural runoff	Aquatic and terrestrial species within and around farming areas **Moderate**	The project's construction of irrigation canals, flood control structures, and farm roads will involve large-scale earthworks, potentially leading to soil erosion and sedimentation, impacting water quality in rivers and canals crucial for irrigation. The removal of vegetation and ground disturbance during construction increases the risk of soil erosion and runoff, carrying sediment and pollutants into water sources used for irrigation and livestock. This pollution, coupled with the potential for increased use of agrochemicals due to enhanced irrigation capacity, could negatively affect water quality, impacting the health of both crops and livestock. Furthermore, the construction activities could disrupt natural habitats, affecting species that play vital roles in pest control and pollination, essential for a healthy farming ecosystem.	Indirect	- Restrict the movement of heavy machinery to designated areas and use appropriate construction techniques to reduce soil compaction. - Implement erosion and sediment control measures such as silt fences, sedimentation basins, and hay bales to prevent soil loss and protect water quality. - Construction vehicles and machinery have to wash only in designated areas where runoff will not pollute natural surface water bodies. - Establish proper drainage systems to divert runoff from construction sites and prevent it from contaminating water sources used for irrigation and livestock. - Encourage the adoption of

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
leading to reduced yields and potential health issues.					sustainable agricultural practices, such as reducing pesticide and fertilizer use, to minimize pollution from agricultural runoff. Develop and implement a comprehensive water management plan that ensures the efficient use and allocation of water resources, minimizing the risk of over-extraction and downstream water scarcity.
• **GHG emission** - The construction and operation of heavy machinery, such as excavators and bulldozers, during these projects release carbon dioxide (CO2) into the atmosphere, i.e. the energy requirements for construction works can result in increased carbon emissions - At the time of construction, there are possibility of smoke generated by burning of straw in the rice field.	• Rehabilitation of irrigation canals and farm roads. • Use of heavy machinery for excavation, transportation, and construction. • Waste burning at worker campsites. • Burning of rice straw in the fields by farmers. • Rehabilitation of irrigation canal and farm roads and burning of straw of farmers at the rice field	Atmosphere **Minor**	The production and transportation of excavated soils and materials further add to greenhouse gas (GHG) emissions. However, due to the short duration of these construction activities, the overall increase in emissions is expected to be minimal and relatively small in scale.	Direct and indirect, and short and long term	- Use energy-efficient machinery and equipment during construction to reduce fuel consumption and emissions. - Optimize construction logistics to reduce the number of vehicle trips and machinery usage, minimizing fuel use and emissions. - Implement proper maintenance programs for equipment and vehicles to ensure they operate efficiently and with lower emissions. - Reduce deforestation and land-use changes that contribute to carbon emissions by preserving vegetation and replanting trees in affected areas. - Use low-carbon materials and construction techniques that reduce the embodied carbon in construction materials. - Offset unavoidable GHG

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					emissions by investing in carbon offset projects, such as reforestation or renewable energy initiatives. - Engage with local communities and stakeholders to raise awareness of emission reduction practices and encourage their participation in sustainability efforts.
DURING OPERATION					
ENVIRONMENTAL POLLUTION					
• **Hydrology** - Increased irrigation demands could deplete water sources, if management is not properly conducted. - This may lead to poor management of environment flow for the water system	• Increased irrigation. • Poor water management practices • Climate change impacts (altered rainfall patterns)	• Tonle Sap Lake. • Upstream Watersheds • Wetlands • Aquatic Ecosystems • Downstream Communities **High**	Irrigation systems can have both positive and negative effects. Proper design and management are essential for reducing negative impacts on the natural hydrological cycle.	Direct and Indirect	- Implement water-saving irrigation technologies like drip irrigation and sprinkler systems to reduce water consumption and minimize the strain on water resources. - Encourage the adoption of the AWD technique in rice cultivation to optimize water use and reduce water withdrawals for irrigation. - Establish detailed water management plans that ensure equitable water distribution and allocation, considering the needs of various users and the environmental flow requirements to maintain healthy aquatic ecosystems. - Design and construct robust irrigation infrastructure, including canals, ponds, and storage areas, capable of withstanding extreme

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					weather events like floods and droughts. This investment should also include lining canals and refurbishing storage areas to reduce water losses and improve water storage capacity. - Integrate natural infrastructure, such as wetlands and forests, into water management strategies. Protect and restore degraded habitats to enhance their water regulation capabilities, improve water quality, and support biodiversity. - Establish and provide training to FWUCs on sustainable water management practices, equitable water rights, and allocation procedures. These communities play a vital role in the operation and maintenance of the irrigation system, ensuring its long-term sustainability.
• **Water pollution:** - Increased use of chemical for intensified crop production may affect the overall water quality and affect people who rely on such water for domestic use. - Impacts may include two levels: impact on surface water as immediate effect and underground water as long-term impact.	• Intensification of agricultural production	• Famers • Nearby residents • Aquatic ecosystems within the command areas and downstream, including the	When the irrigation become operationalize, the use of chemicals for farming activities can create potentially impact on soil and water quality, the extent of this impact is likely to be relatively moderate due to the intensification of agricultural production and changes in practices in the command areas as irrigation water become more available. The widespread use of chemical fertilizers and pesticides for rice production, particularly when optimized for higher	Direct, indirect, and cumulative	- Implement Simplified Pesticide Management Plan - Conduct regular water quality test to track the change in water quality due to pesticide application using oversea laboratory testing

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
		Tonle Sap Lake. **Moderate**	yields, is far significant contributor to soil and water quality degradation. These agricultural practices can lead to soil nutrient depletion, salinization, and pollution, ultimately compromising the long-term sustainability of agricultural production whereas water with high concentrations of pesticides may affect the biodiversity not only within the command areas but also within the river body downstream, possible in the Tonle Sap Lake.		
• **Soil pollution/ quality reduction:** Overuse of Agri-chemicals (e.g., chemical pesticides, fertilizers, etc.)	• Increased agricultural production Lack of training or adoption of sustainable farming practices.	• Soil Health • Water Quality • Biodiversity **Moderate**	Increased production could lead to overuse of agri-chemicals if farmers are not adequately trained or supported in adopting environmentally friendly practices.	Direct and Indirect	- Implement Simplified Pesticide Management Plan - Conduct regular soil quality test to track the change in water quality due to pesticide application using oversea laboratory testing
BIODIVERSITY					
• **Habitat Loss and Fragmentation:** - Conversion of land: Flooded forests and wetlands may be drained or filled to create more arable land for agriculture, leading to significant loss of habitat. - Fragmentation: Remaining natural habitats may become isolated patches, making it difficult for species to migrate, find mates, and maintain healthy populations.	Intensifying farming	Aquatic and terrestrial species **Moderate**	At the micro, local, and regional levels, habitat loss is likely to occur due to land clearance during the construction phase, with further possible expansion into the protected areas nearby. For instance, the planned construction of a canal through community forestry in Lum Hach can create a good access to land for settlement along the canal. In addition, the expansion of agricultural land into the protected area downstream of Ou Ta Paong may also occur which are added to the conversion of microhabitats across the command areas. This loss is driven by farmers seeking to maximize profit from available land, and the scale of habitat conversion could extend beyond the	Direct and indirect	- Implement Biodiversity Action Plan

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
			local level, potentially impacting the region.		
- **Invasive Species:** Introduction of Non-Native Species: Changes in land use and water management can introduce invasive plant and animal species that outcompete native species and alter ecosystem dynamics	Intensifying farming	Aquatic and terrestrial species **Minor**	Changes in hydrological conditions, such as altered water flow and flooding patterns due to irrigation infrastructure, can create favourable conditions for invasive species to establish themselves in wetlands. These disruptions weaken the natural resilience of native species, making the ecosystem more vulnerable to colonization by invasive plants and animals. This can result in a decline in biodiversity, altered nutrient cycling, and degraded water quality. Once invasive species become established, they are difficult to remove and can cause long-term ecological damage, further diminishing the wetland's ability to provide essential ecosystem services. This is particularly concerning for areas like Ou Ta Paong and Stung Krang Bat, where water flows in both directions from and to the Tonle Sap Lake, increasing the risk of invasive species spread. The scale at Ou Ta Paong is large and the impact can be moderate.	Direct and indirect	- Implement Biodiversity Action Plan
• **Hunting, trading, and consumption of animal from the wild:** Even after the construction being completed, there may be the continuation of the hunting as market are available.	• Intensifying farming • Increased demand for wild animal products.	Aquatic and terrestrial species, particularly those already threatened or endangered. **High**	Although the activities are likely to continue, it is not directly caused by the project activities, but it can expand further beyond the completion of the construction. The impact is minimal and considered to be regional, if trading continues to exist.	Indirect, and short and long term	- Implement Biodiversity Action Plan
CLIMATE CHANGE					

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
• GHG emission - The intensification of farming activities meaning that rice production will be increased into more times or more whereas the energy that are required for the production can be also increased. - Smoke may be generated due to burning of straw in the rice field, particularly when water access for irrigation being increased. - This will lead to the increase of volume of GHG emissions being emitted into the atmosphere.	• Intensifying farming activities • Increased used of energy for farming activities	Atmosphere **Minor**	Increased farming activities, driven by improved irrigation, can lead to higher GHG emissions due to factors such as fertilizer use, livestock production, and rice cultivation. Additionally, the energy requirements for operating pump stations, flood control systems, and other infrastructure elements can contribute to increased carbon emissions if not managed efficiently. These factors collectively highlight the potential for the project to have a significant impact on GHG emissions.	Direct and indirect	- The project is to promote sustainable practices like crop rotation and agroforestry to reduce energy consumption and improve soil health. - The project needs to introduce renewable energy sources such as solar-powered irrigation to lower the carbon footprint of rice production. - The project needs to support on training farmers to use alternatives to straw burning, such as mulching or biomass energy generation, to reduce air pollution. - The project promotes the utilization of efficient irrigation methods like alternate wetting and drying (AWD) to conserve water and minimize methane emissions. - The project needs to advocate for policies that discourage straw burning and provide incentives for adopting sustainable agricultural practices.
ANNUAL CROP MANAGEMENT PLAN					
WATER					
• **Water resource efficiency:** Over-extraction of water resources can lead to downstream water scarcity, altered hydrology, and damage to aquatic ecosystems.	• Inefficient irrigation practices during operation	Downstream communities, aquatic ecosystems **Moderate**	Inadequate water management poses a significant risk to the long-term sustainability of water resources and dependent ecosystems and communities.	Major, if not managed properly.	Project need to implement efficient water management practices to prevent over-extraction and ensure equitable water distribution. This can include:

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					- water use monitoring system to track consumption and identify areas for improvement. - implementing appropriate irrigation scheduling based on crop water requirements and weather conditions. - Utilizing efficient irrigation systems, such as drip irrigation or sprinkler systems, to minimize water loss. - Exploring opportunities for water reuse, such as capturing and reusing runoff water.
SOIL AND SOIL MANAGEMENT					
Soil erosion and soil erosion risk: Soil erosion can lead to loss of topsoil, reduced soil fertility, and increased sedimentation in water bodies.	• Land preparation activities such as tillage, site clearing, and the use of heavy machinery can increase the risk of soil erosion.	Soil health, water quality, and agricultural productivity. **High**	Unsuitable management techniques and land preparation activities can lead to the physical and chemical degradation of soils.	Potentially major, especially during periods of heavy rainfall or in sloping areas.	- Minimize soil compaction and disturbance by using appropriate machinery and timing land preparation activities. - Consider erosion management practices such as contour planting, terracing, and grass barriers. - Adopt reduced tillage or no-till farming practices to minimize soil disturbance. - Establish cover crops during fallow periods or in rotation with main crops to protect the soil from erosion. - Practice contour farming on sloping land to reduce runoff and erosion. - Construct terraces on steep slopes to prevent soil loss.

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					- Establish windbreaks or shelterbelts to reduce wind erosion. - Install erosion control structures, such as grassed waterways or sediment basins, to manage runoff. - Apply mulch to the soil surface to protect it from rainfall impact and erosion.
• **Nutrient application and management:** Excessive or improper nutrient application can lead to nutrient runoff and leaching, contaminating water resources and causing eutrophication.	• Excessive or improper application of fertilizers can lead to nutrient runoff and leaching.	Water quality, aquatic ecosystems, and human health **High**	Over-fertilization and nutrient runoff can contaminate water resources, negatively impacting aquatic ecosystems and potentially leading to eutrophication.	Potentially major	- Conduct periodic soil analysis to determine nutrient needs and avoid over-fertilization. - Establish buffer zones near watercourses to filter nutrient runoff. - Consider using green manures and cover crops to replenish soil nutrients and reduce leaching.
PESTICIDE					
• **Use and effectiveness of pesticides:** Pesticide use can have adverse effects on human health, non-target organisms, and the environment. Pesticide resistance can develop, requiring increased application rates.	• Application of pesticides.	Human health (farmers and consumers), biodiversity, soil and water quality **High**	Pesticide use can have unintended consequences on human health, biodiversity, and environmental quality if not managed carefully.	potentially major	- Promote Integrated Pest Management (IPM) strategies to minimize pesticide use. - Implement training programs for farmers on the safe handling and application of pesticides. - Ensure proper disposal of pesticide containers and leftover products.
• **Pesticide residues on site soil:** Pesticide residues can accumulate in the soil, potentially contaminating groundwater and impacting soil organisms.	• Repeated pesticide applications, use of persistent pesticides, and improper disposal of	Soil health, biodiversity, water quality High	Pesticide residues can accumulate in the soil, potentially harming soil organisms and affecting water quality.	Potentially moderate to major	- Promote the use of pesticides with low persistence and mobility in the environment. - Implement a soil monitoring program to assess pesticide residue levels.

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
	pesticide containers.				- Consider crop rotation and the use of cover crops to help break down pesticide residues. - Minimize pesticide use by adopting IPM strategies. - Conduct soil testing to monitor pesticide residue levels. - Rotate crops to break pest cycles and reduce the need for repeated pesticide applications. - Utilize cover crops to improve soil health and enhance pesticide degradation. - Consider bioremediation techniques to remove pesticide residues from contaminated soil.
• **Pesticide residues on produce:** Pesticide residues on produce can pose health risks to consumers.	• Late pesticide applications close to harvest, improper pesticide application techniques, and inadequate pre-harvest intervals.	Consumers, human health.	Pesticide residues on produce can pose a risk to consumer health. **Moderate**	Potentially major	- Enforce pre-harvest intervals to allow for pesticide breakdown before harvest. - Promote the use of pesticides with low toxicity to humans. - Properly wash and handle produce to remove surface residues. - Implement a monitoring program to test produce for pesticide residues. - Ensure compliance with established MRLs for pesticide residues on produce.
AIR QUALITY, AIR EMISSIONS, AND ENERGY USE					
• **Energy use:** Energy consumption contributes to greenhouse gas	• Operation of machinery and equipment for	GHG emission, air quality, and	Increased energy use for farming activities, especially those powered by fossil fuels, can contribute to air	Potentially significant	The project needs to:

Risks and Impacts	Key activities that cause risks and impacts	Receptors/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
emissions and impacts operating costs.	various farming activities (tillage, irrigation, harvesting, transportation) and the use of energy for processing and storage.	operational costs	pollution and greenhouse gas emissions. **High**		- Promote the use of energy-efficient machinery and equipment. - Explore the use of renewable energy sources (solar, biofuels) for powering irrigation pumps and other farm operations. - Encourage the adoption of sustainable practices that reduce energy needs, such as crop rotation, no-till farming, and optimized irrigation scheduling.

3.2 Social Risks and Impacts

A Social Impact Assessment (SIA) is a systematic process used to analyze, monitor, and manage the social consequences of planned interventions, such as policies, programs, plans, or projects. It aims to identify, predict, and mitigate potential negative social impacts while maximizing positive ones.

Methods:

- Participatory Rural Appraisal (PRA): Engage local communities through focus group discussions, interviews, and mapping exercises to identify their concerns, needs, and perceptions of the project.
- Social Surveys: Conduct structured surveys to gather quantitative data on socio-economic conditions, livelihoods, and potential impacts on households.
- Key Informant Interviews: Interview key stakeholders, such as local leaders, government officials, and experts, to gain insights into local dynamics and potential risks.

Data/Information:

- Baseline Data: Collect baseline data on demographics, land use, water resources, livelihoods, and social indicators.
- Secondary Data: Utilize existing data from government agencies, research institutions, and other relevant sources.
- Primary Data: Gather primary data through field surveys, interviews, and observations.

Consultations:

- Individual Consultations: Conduct one-on-one consultations with key individuals and groups to address specific issues and concerns.

The assessment of environmental and social risks and impacts involves both the identification of risks and the identification of impacts. The identification of risks involves with three steps: the risk identification, risk analysis, and risk evaluation (Figure 7) whereas the assessment of impacts involves with five steps: characterizing the impacts, identifying the nature and duration of the impacts, determining the impact significance, determining the level of impact likelihood, determining the impact scale, determining the measures to mitigate the impacts, assessing the residual impacts after mitigation, and determining receptor sensitivity/vulnerability.

Table 13: Social risks and impacts

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
BEFORE CONSTRUCTION					
LAND ACQUISTION					
• **Land acquisition and resettlement:** The most noticeable locations that required the acquisition of land include the feeder canals, river at Ou Ta Paong sub-scheme, mainstream at Lum Hach and along the existing canals which are planned to rehabilitate. The temporary acquisition of land for construction may also cause economic disruption while some households may lose their houses, or livelihood activities on the embankment of the river and canals. When river is rehabilitated some households along Ou Ta Paong River may loss land for housing, fruit trees, and agricultural production	• Rehabilitation of irrigation canal and farm roads	• Landowners • Informal land users, Informal resettles • Nearby construction site business owners/ **Moderate**	Land acquisition is anticipated for all six sub–schemes. However, the land acquisition varies from scheme to scheme – based on the initial concept design. It is expected that land acquisition is highest at Ou Ta Paong, followed by Lum Hach. Land acquisition is anticipated to be minor for Brambei Mom, Krapeau Trom and Yutasas because these schemes are much smaller (compared to Ou Tapaong and Lum Hach) and no expansion of existing canals	Direct and indirect	The actual estimate of the land acquisition and land acquisition impacts has been on the process. The ESCIA team is working with the PMU, local authorities and communities to identify the scope of land acquisition and resettlement impacts of each sub-scheme. The information on the scope and cost estimate including the potentially affected households and persons, affected lands affected assets and affected income and livelihoods will be made available at the end of December 2024 as per the available information of the final concept design and decision making on the options of construction in each sub-scheme. However, the figure may be changed after the availability of the DED.

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
permanently. In command areas at Krang Ponley where existing canals need to be extended, or new canal need to be built, minor land acquisition may be required to allow canal construction.			system is not planned during project preparation.		
• **Economic displacement** - Households in Ou Ta Paong and Lum Hach's main canal, particularly those with production land along the water bodies, including non-titled land users and informal settlers, face a significant risk of economic displacement due to the project. As the systems will be upgraded, these informal farming areas may be removed due to dredging. Thus, these households may be affected and thus lose the opportunity to grow crop for food and/or income. - During the construction phase, local businesses and transportation routes may experience disruptions, potentially affecting the community's daily life and ongoing economic activities. Household infrastructure, such as pumping systems and water pipes, may also be impacted by construction activities. - Additionally, temporary housing for farm care may be necessary, further disrupting agricultural practices. Furthermore, canal blockages due to construction activities could	• Nearby residents	• Landowners • Informal land users, Informal resettles Nearby construction site business owners **Moderate**	During the construction phase, the track-out of construction material transportation and the construction area will be affected directly on the economic activities of community people such as local businesses, transportation routes, rice production land, and daily movement within the command area. Diversion of water from the original channels can also cause the disruption of agricultural production, even crop failure. Once again, the estimated impact of economic displacement is still early to conclude.	Direct and indirect	The actual estimate of the economic displacement has been on the process. The ESCIA team is working with the PMU, local authorities and communities to identify the scope of economic displacement of each sub-scheme. The information on the scope and cost estimate including the potentially affected households and persons, affected lands affected assets and affected income and livelihoods will be made available at the end of December 2024 as per the available information of the final concept design and decision making on the options of construction in each sub-scheme. However, the figure may be changed after the availability of the DED.

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
hinder water flow, impacting cultivation during planting seasons and potentially leading to reduced agricultural yields.					
Facility Design • Poorly designed irrigation systems may lead to environmental disruption, where dredging disturbs aquatic ecosystems and degrades water quality. Structural failures in poorly designed or constructed components can lead to collapses or damage during extreme weather events. Misaligned or undersized culverts and structures may obstruct water flow, causing flooding or reduced irrigation efficiency. Additionally, these activities can alter sediment transport, leading to upstream sedimentation, downstream erosion, and land instability.	• Detail Engineering Design	• All **High**	CAISAR project aims to achieve the environmental-friendly, and climate resilience aspect. These aspects need to be carefully considered with all possible options to be included in the design. In this regard, it is expected to be fully considered and reduce the impacts at the minimum.	Direct and indirect	• Ensure designs comply with recognized engineering standards and best practices for irrigation systems. • Use materials and designs that can withstand extreme weather conditions such as heavy rainfall, flooding, and drought. • Engage independent experts to review designs and construction plans to ensure quality and durability. • Conduct detailed hydrological studies to appropriately size culverts, canals, and structures to prevent water flow obstruction and ensure efficient irrigation. • Use adjustable gates and control structures to regulate flow during variable water conditions. • Plan for ongoing inspection and maintenance to address obstructions or sediment buildup that might impede water flow. • Include riprap, geotextiles, and vegetation around banks and structures to reduce erosion and stabilize land. • Install weirs, sediment barriers, or retention ponds to control sediment movement and accumulation. • Monitor and mitigate sedimentation or erosion impacts on adjacent areas, including upstream and downstream locations. • Involve local communities, water user groups, and stakeholders in the planning and design process to address their

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					concerns and incorporate local knowledge. • Provide training to local operators and stakeholders on system maintenance and sediment management practices. • Strengthen local authorities' capacity to oversee construction and monitor irrigation system performance.
DURING CONSTRUCTION					
CHILD LABOR & FORCED LABOR					
• **Child Labor**: The risk of child involvement in project's labour force (e.g., contractors' labour) is foreseen because subproject activities will take place in rural areas where use of child labour is common. There is a possibility that local people under 18 years is engaged by construction contractors and subcontractors to perform unskilled works.	• Construction or Rehabilitation of irrigation canal and farm roads	• Unskilled workers (mostly local people)/ **Moderate**	Contractors are likely to employ children or youth who are under the legal working age, as defined by the country's laws due to labour shortages and the drive to maximize profits, the use of child labour may occur, especially in the context of weak law enforcement and inadequate monitoring by relevant institutions. The scale of this abuse depends on the number of workers involved during the construction phase, and it can directly impact both local individuals and migrant labour forces.	Direct	- Apply LMP for age check prior to engagement of labor with regular monitoring through proper screening and registering all workforce for the work - To mitigate the risk of child labor, the project will implement strict measures to ensure compliance with national and international labor laws. Regular monitoring and inspections will be conducted to identify and address any instances of child labor. - Additionally, awareness-raising campaigns will be implemented to educate communities about the harmful effects of child labor and the importance of sending children to school. The project will also collaborate with local authorities and NGOs to strengthen law enforcement and provide support services to vulnerable children and their families.
• **Forced Labor:** Risk of workers being forced to work (e.g. young people) to	• Construction or Rehabilitation of	• Nearby residents	Construction companies may reduce their workforce and pressure employees to work	Direct, and temporary	- Strict Code of Conduct for workers with no tolerance for physical or verbal

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
earn income for their family, and/or to pay debt. Additional, forced labour refers to any work or service that are not voluntarily performed by an individual under threat of force or penalty. Forced labour could happen for both children under 18 and adults, particularly for households who are in high need to cash for specific family purpose (e.g. cover a medical bill, paying debt…). The risk of engaging of forced labour might be associated with workers that are considered as "primary supply workers" as identified under the project's Labor Management Procedures.	irrigation canal and farm roads	such as children and youth • Construction workers/ **High**	faster to save time and cut costs, often without proper negotiation or prior notice. In the absence of strong government oversight and a functioning labour monitoring system, these practices can occur during the construction phase. However, while such behaviour is likely, the impact may be mitigated, as the current presence of social media can serve as a deterrent to contractors engaging in these illegal activities.		abuse of women or children - The Project Owner and Sub-Contractors will collaborate with the relevant Government Agency to disseminate information to local communities. This information will include the Contractor's Code of Conduct and the minimum working age as mandated by national laws and international standards. - The Ministry of Water Resources and Meteorology (MOWRAM) will provide information to local communities about the contractor's policies and responsibilities, including the Contractor's Code of Conduct and minimum working age.
COMMUNITY HEALTH AND SAFETY					
• **Disease transmission:** - Spreading and contracting of communicable diseases of labour forces having direct and indirect contact among themselves - Risk of contracting non–communicable diseases of among workers and with community people due to their working behaviours and pressures at the time of working away from home.	• Construction or Rehabilitation of irrigation canal and farm roads	• Nearby residents • Construction workers/ **High**	During the construction period, some workers experience poor eating habits, homesickness, being away from home, and stress from demanding task which lead to poor health condition as well as they are possibly the disease carriers which can spread to the other workers and community people. Unsanitary living conditions may also contribute to the spread of communicable diseases. These problems are high and likely prevalent among the construction workforce and can	Direct and indirect, and temporary	- Conduct public awareness raising activities (IEC) to ensure local people and contractors know about the risks of contracting and spreading communicable diseases such as COVID-19, HIV/AIDS, and water-borne diseases (e.g., amoebiasis, giardiasis, and toxoplasmosis. etc. - In the event of a disease outbreak (e.g. COVID-19), provide immediate training/awareness raising to the risk groups. - Conduct training to workers on communicable diseases prior to mobilization to construction sites.

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
			also affect the surrounding community as short and long term.		- For water-borne diseases that arise due to polluted or contaminated water, mitigations measures may include: o Implement filtration, chlorination, or UV disinfection to ensure safe drinking water. o Build and maintain proper sewage systems and latrines to prevent water contamination. o Promote handwashing, safe food preparation, and proper sanitation practices in communities. o Control and properly dispose of waste to prevent water pollution. o Test water sources frequently for contamination and take corrective actions promptly. o Provide access to clean water supplies, such as bottled water or tankers, during outbreaks or disasters. o Promote immunizations against water-borne diseases like cholera and typhoid in high-risk areas.
• **Sexual Exploitation and Abuse, Sexual Harassment** (due to labour influx): The risk of Sexual Exploitation and Abuse (SEA), Sexual Harassment (SH SEA/SH) is anticipated to be “Moderate” due to 1) concentration of labour, 2) frequent visits of project workers, and 3) increased level of this risk due to pre-existing SEA/SH issues in the	• Rehabilitation of irrigation canal and farm roads	• Project workers • Local peoples, especially the vulnerable including female and	Away from home labour forces, approximately 200 workers as per estimate of the ESCIA team, are lonely and possibly wanting to engage in sexual abuse either with the community people or among the workers. The magnitude of the risks depends on organizational behaviour as well as the effectiveness and	Direct and indirect, and temporary	- Contractors need to explicitly state zero tolerance for sexual harassment, exploitation, and abuse within the workplace. - Require Code of Conduct (CoC) to be signed by all construction workers. - For victims coming forward: referral to qualified SEA/SH service provider. - The GRM will include a confidential channel for reporting SEA/SH.

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
subproject's area of influence. It is noted that labour influx includes not only workers but also people who are local and nonlocal that gravitate to construction sites temporarily to provide logistics services for contractor's workers during construction stage. This risk of Violence Against Children (VAC) is also anticipated due to increased level of SEA/SH and pre-existing risk of local domestic violence that might be present before the project.		children/ **Moderate**	efficiency of the management of the construction companies while it can occur directly within the community or the construction site. This can be regionally connected due to the association of such exploitation and human trafficking. However, it is unlikely to occur as the current human trafficking seems to be rarely reported. The consulted stakeholders, especially the province and district level, concern that the presence of construction workers will cause potential issues of sexual exploitation, gender-based discrimination, and child labour. Additionally, there are concerns about the potential for drug use and abuse among workers by community people, which could lead to unsafe working conditions and negative impacts on surrounding communities.		- Strict Code of Conduct for workers with no tolerance for physical or verbal abuse of women or children - Training to workers on maintaining good community relations, with emphasis on proper conduct around women and children. - Training on SEA/SH and VAC for community members, in particular women and girls (may be done separately for men and women). - Ensuring workers' sites are situated (at least 500m) from schools and/or other areas where children congregate. - Children are prohibited from construction sites and worker's camp. - Ensure access to grievance redress mechanisms for all project-affected persons, including both stakeholders and workers, to address Sexual Exploitation and Abuse, and Sexual Harassment. Support (in the form of training, awareness raising, etc.) to local law enforcement to act on community complaints regarding SEA/SH and VAC. - Provision of information to local communities about the contractor's policies and responsibilities, including the Contractor's Code of Conduct and minimum working age. - Provide counselling services for male and female workers, wives and other female partners of contractors' workers.

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					- Build partnerships with local health providers and SEA/SH service providers to conduct community awareness activities, and referrals. - Implement public awareness campaigns to address sexual harassment in transport services and hubs, and training of police on women's security needs when using transport. This is included on GRM: • Accessibility for Workers • Multiple Reporting Channels • Confidentiality and Support • Contractor Accountability
• **Security and Road and Traffic safety:** Increased risk of road accidents, local security, particularly for people living in the vicinity of the civil works and those traveling near the construction areas - Unauthorized access to construction sites, leading to theft or vandalism of equipment and materials. In addition, inadequate site surveillance or fencing may also expose the project to sabotage or delays caused by intentional interference. - During construction phase, particularly when road condition is not good, and safety measures are not effectively carried out by contractors. Risk of road accident may be due to people' failure in	• Rehabilitation of irrigation canal and farm roads	• Project workers, • Community people • Local people traveling near construction sites and on transportation routes • Risk is mostly with those making frequent road travel **Moderate**	Unknown conditions of workers or some local people may involve in stealing thing from the construction sites or from local community. This may cause conflict within the community and feeling of unsafe as per the arrival of the influx labour. Moreover, construction vehicles transport petroleum, excavated soil, cement, and other building materials, leading to increased traffic activity in both urban and rural areas within the project zone and along the roads to the dumping sites or from access roads. This raises the risk of accidents and injuries directly for nearby residents, especially if safety measures are not	Direct, and Indirect	- Arrange security guard or engage local authority to guard the construction sites - Conduct public awareness raising activities (IEC) to ensure local people and road user are aware of road safety regulations and risks and act accordingly while using road. - Monitor and observe speed limit;

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
attending their children which put children at risks of accidents. - Given increased traffic flow between construction sites and other destination such as borrow pit, quarry, material supply warehouses, there is a risk of road traffic accident on the part of contractors' workers, and local inhabitants such as pedestrians, motorcyclists, cyclists, and those on animals or animal drawn carts. Reasons may also include violation of speed limits, lack of awareness of pedestrian, drivers' behaviour/drunk driving, or unexpected certain traffic circumstances. All project workers and local people near construction sites and routes connecting construction sites and material supply sites, quarry, borrow pits are exposed to traffic and road safety risks.			rigorously followed. However, the volume of materials transported during the construction phase is still unknown and potentially medium for a short duration. As a result, the potential impact on road and traffic safety for people living along the transportation route is considered moderate. Community people showed limited concerns about the issues as they are unable to navigate the risks while some concerns were stated by authorities regarding the issues and requested for careful consideration from relevant institutions and involvement of local security forces.		
• **Community Health and diseases** - Spreading and contracting of communicable diseases due influx of labour forces having direct and indirect contact with local people - Construction activities can disturb existing sediments and pollutants, temporarily increasing the risk of waterborne diseases	• Rehabilitation of irrigation canals and farm roads. • Influx of construction workers into the project area. • Construction activities disturbing soil	• Nearby residents • Construction workers/ **Moderate**	The influx of workers for the construction phase raises concerns about the potential spread of communicable diseases. Disturbing sediments during construction could elevate the risk of waterborne diseases, particularly if sanitation and hygiene practices are inadequate.	Direct and indirect	- Ensure that safe drinking water and adequate sanitation facilities are available for both workers and the surrounding community to prevent waterborne diseases. - Organize health education campaigns for workers and community members, focusing on hygiene, safe water use, disease prevention, and the proper use of sanitation facilities. - Implement vector control measures,

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
	and water bodies.				including regular drainage of stagnant water, distribution of insecticide-treated bed nets, and community spraying programs. - Provide workers with appropriate personal protective equipment (PPE) such as masks, gloves, helmets, and other safety gear to protect against respiratory diseases, dust, and physical injuries. - Implement proper waste disposal systems for construction debris and hazardous materials, along with measures to prevent air, water, and soil contamination from the construction site. - Conduct regular health screenings for construction workers, especially for communicable diseases such as tuberculosis, and other infections. - Establish a grievance mechanism specifically for health-related issues, allowing community members to report any health concerns or complaints related to construction activities. - Monitor health trends in the project area, including disease outbreaks or unusual health issues, and report findings to local health authorities for coordinated action. - Implement dust suppression techniques, such as regular watering of roads, limiting construction activities during high winds, and using dust barriers where possible.

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
OCCUPATIONAL HEALTH AND SAFETY					
• **Physical Hazards.** Physical hazards represent potential for accident or injury or illness due to repetitive exposure to mechanical action or physical activities. Physical hazards may result in a wide range of injuries, from minor that needs medical aid only, to disabling, catastrophic, and/or fatal. - Accidents due to falls: falling from ladders, scaffoldings, and vehicles, etc. - Drowning and water injury accidents: at construction sites, workers may have to walk on structure above the water. - Accident due to falling objects: tools, machinery, equipment, and materials used during construction may fall from the height, causing injuries or death. - Fall into open holes: holes, manhole, and areas of deep excavation may be commonly found at works. - Physical injury related to the operations of heavy equipment: Injury or death may result during operations of heavy equipment, such as crane, excavator, cuts, and bruises on sharp objects etc.	Construction or Rehabilitation of irrigation canal and farm roads	• Construction workers • Inspectors • Visitors • Nearby Residents and Children • Domestic animals/ **High**	Working in the construction field can result in injuries or fatalities if the construction company fails to comply with laws and safety standards. This is likely to occur which may lead to injuries, illnesses, and fatalities due to unsafe practices. It will be directly occurred with the workers during their work. However, such a risk may be minimal based on the number of workers to be engaged for the construction work. Stakeholders at community level limited raised the concern regarding these aspects as they have limited understanding on the matter. At district and provincial level, there are minor concerns regarding the hazard which may cause to construction workers and community people.	Direct and indirect, and temporary	- Fence off all work sites adjacent to communities to avoid unauthorized access to the project sites and to prevent potential injuries. - Display warning signs including at unsafe locations. - If school children are in the vicinity, traffic safety personnel direct traffic during school hours. - Control driving speeds of project vehicles particularly when passing through communities or nearby schools, health centers or other sensitive areas. - Make sure the community is aware of the GRM and that they can access it. - Appoint an Environmental Health and Safety Officer (EHSO) who shall be responsible for training, monitoring and reporting on ESHS concerns and implementing health and safety related programs. - Conduct orientation for construction workers regarding emergency response procedures and equipment in case of accidents (i.e. head injury from falling, burns from hot bitumen, spills of hazardous substances, etc.), fire, etc.; health and safety measures, such as on the use of hot bitumen products for

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
• **Chemical hazards**. Chemical hazards represent potential for illnesses or injuries, both short and long term, and fatalities due to single acute exposure or chronic repetitive exposure to toxic, corrosive, sensitizing or oxidative substances. Common chemicals used in construction include Portland cement clinker (mineral binders), formaldehyde (wood-based materials), polyurethane, vinyl, cadmium, or lead (paints and resins), and solvents. They also represent a risk of uncontrolled reactions, including the risk of fire and explosion, if incompatible chemicals are inadvertently mixed.	Construction or Rehabilitation of irrigation canal and farm roads	• Construction Workers • Inspector • Visitors **Moderate**	Working in the construction field can result in injuries or fatalities if the construction company fails to comply with laws and safety standards. This is likely to occur which may lead to injuries, illnesses, and fatalities due to unsafe practices. It will be directly occurred with the workers during their work. However, such a risk may be minimal based on the number of workers to be engaged for the construction work. Stakeholders at community level limited raised the concern regarding these aspects as they have limited understanding on the matter. At district and provincial level, there are minor concerns regarding the hazard which may cause to construction workers and community people.	Direct and indirect, and temporary	paving of project roads, etc.; prevention of HIV/AIDS, malaria, diarrhea, and other related diseases, as well as Code of Conduct (including discussion of SEA/SH/VAC). - Regularly train/remind drivers of strictly observing speed limits and exercise good driving practices when driving construction supported vehicles through residential areas as well as other sensitive areas such as schools, pagodas, hospitals, markets, and other populated areas, including parking. - Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials by providing covers over transporting dump trucks. - Barriers (i.e., temporary fence) shall be installed at construction areas to deter pedestrian access to these areas except at designated crossing points. - Sufficient lighting at night as well as warning signs should be provided in the periphery of the construction site. - The public/residents, and in particular children, shall not be allowed in high-risk areas, i.e., excavation sites and areas where heavy equipment is in operation. - Provide fencing on all areas of excavation greater than 2m deep. - Ensure reversing signals are installed

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					on all construction vehicles. - Measures to prevent malaria if in areas where malaria is an issue, shall be implemented (i.e. provision of insecticide treated mosquito nets to workers, spraying of insecticides, installation of proper drainage to avoid formation of stagnant water, etc.). - Discharge of untreated sewage shall be prohibited. - Conduct road safety training for workers and roadside community. - Provide trainings on HIV/AIDS and STDs to workers and the community (separately) - Provide trainings on SEA/SH and VAC to workers and the community (separately) - Ensure particular attention is provided to the needs of women and other vulnerable persons. For instance, specific trainings for them should be facilitated by appropriate trainers (i.e. women-only training on HIV/AIDS and/or SEA/SH should be led by a female trainer). - Ensure access to grievance redress mechanism. - Ongoing consultations and awareness raising of local communities.
• **Personal Protective Equipment.** During dredging, and the construction of culverts, structures, and dams	Construction or Rehabilitation of	• Construction Workers • Inspectors	With the construction to be occurred at the rural areas, it is possible that construction	Direct and indirect, and temporary	- Continue and active use of PPE at all time of construction - Identification and provision of

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
presents serious risks to worker safety and health. Workers are exposed to hazards such as falling debris, sharp objects, and heavy machinery, increasing the likelihood of injuries, including cuts, fractures, or head trauma. The lack of respiratory protection may lead to inhalation of dust, fumes, or toxic substances, while inadequate eye and hearing protection can cause vision impairment or hearing loss due to flying particles and high noise levels. Additionally, the absence of proper footwear and gloves increases risks of slips, trips, falls, and contact with hazardous materials. Prolonged exposure to these dangers without PPE not only compromises individual safety but also reduces overall productivity and increases liability risks for the project.	irrigation canal and farm roads	• Visitors **High**	company may try to save the cost as much as possible. Absence of personal safety and consideration of individual who involve in the activities would also be the cause of being careless in using the equipment. This need to be carefully monitored and educated to ensure that the receptors are safe and sound.		appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors, without incurring unnecessary inconvenience to the individual - Proper maintenance of PPE, including cleaning when dirty and replacement when damaged or worn out. - Proper use of PPE should be part of the recurrent training programs for employees
• **Underpaid pay and unequal treatment:** Local people recruited as unskilled workers by project contractors may not be offered a written working contract. As a result, there is a possibility that they may be underpaid compared to the nature, scope, and quantity of work that they are expected to perform. Underpayment may also take place on the basis of gender, temporary work status – at the discretion of	• Construction or Rehabilitation of irrigation canal and farm roads	• Unskilled workers (mostly local people • Construction workers) / **Moderate**	Gender discrimination in the construction workforce may arise from the belief that men are stronger and more capable than women, leading companies to favour male workers. However, many women are equally qualified to perform these tasks. This bias, along with the presence of unregistered labour forces and weak enforcement of labour	Direct	- Implement a grievance mechanism for workers where workers can report issues related to underpayment or unequal treatment without fear of retaliation. - Advise companies to provide equal opportunities for employment and promotions to all workers, regardless of gender, ethnicity, or background, to avoid discrimination. - Regularly monitor and audit payroll and employment practices to ensure

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
contractors. The risks of late wage payment or failing to pay workers should be assessed and included as part of the contract. The risks not only cause the Bank's reputation risk, but also delay civil works. In addition, there is the possibility that they will not comply with the law on labor of the country due to short period contract.			laws, can also result in mistreatment regarding worker payments, further exacerbating the inequalities faced by women in the construction sector. The risk is directly happening with labour forces. However, with the presence of social media and access to support, it is unlikely to occur at a large scale.		compliance with labor regulations and address any disparities. - Offer training and capacity-building programs for all workers to enhance their skills and qualify them for higher-paying roles. - Ensure that subcontractors and suppliers also adhere to fair wage and equal treatment policies. - Set up worker committees or unions to allow collective bargaining and ensure workers have a voice in addressing wage and treatment issues. - Provide accessible information to workers about their rights, entitlements, and the proper channels to address grievances through the establishment of the GRM for workers. This includes training on topics such as: • Environmental and Social Safeguards • Gender Awareness and the Gender Action Plan • Sexual Exploitation, Abuse, and Harassment (SEA/SH) • Labor Rights and the Workers' Code of Conduct - Regularly engage with labor rights organizations or third-party auditors to evaluate labor conditions and make improvements where necessary.
CULTURAL HERITAGE					

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
Several cultural sites have been reported across three sub-command areas: Ou Ta Paong, Lum Hach, and Stung Krang Bat. In Ou Ta Paong, these sites are reported to be minimally associated with the construction areas. However, there is a possibility that smaller sacred places within the command areas could be overlooked and cleared for canal construction. Since the detailed design has not yet been released or discussed with the community, there remains a risk that these sites could be destroyed. In Lum Hach, the two identified cultural sites are reportedly outside the construction areas, but confirmation of the final design is needed to ensure that these sites are not affected. Lastly, in Stung Krang Bat, numerous historical and cultural heritage locations exist. While construction is expected to focus on existing canals, there is potential that the construction will encounter archaeological artifacts buried deep in the soil, as the ancient city of Longvek, once located here, experienced many wars, leading to the possibility that treasures or artifacts of historical significance were hidden underground.	• Rehabilitation of irrigation canal and farm roads	Underground cultural sites/ **Minor**	Several cultural sites have been reported across three sub-command areas: Ou Ta Paong, Lum Hach, and Stung Krang Bat. In Ou Ta Paong, these sites are reported to be minimally associated with the construction areas. However, there is a possibility that smaller sacred places within the command areas could be overlooked and cleared for canal construction. Since the detailed design has not yet been released or discussed with the community, there remains a risk that these sites could be destroyed. In Lum Hach, the two identified cultural sites are reportedly outside the construction areas, but confirmation of the final design is needed to ensure that these sites are not affected. Lastly, in Stung Krang Bat, numerous historical and cultural heritage locations exist. While construction is expected to focus on existing canals, there is potential that the construction will encounter archaeological artifacts buried deep in the soil, as the ancient city of Longvek, once located here, experienced many wars, leading to the	Direct	- Conduct archaeological surveys before construction in culturally sensitive areas. - Implement Find Chance Procedure

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
			possibility that treasures or artifacts of historical significance were hidden underground.		
LOSS OF ACCESS					
Loss access to land and other assets: - Construction activities, particularly land acquisition for canals and roads, can displace communities or restrict their access to land, homes, and other assets. - **Temporary** restriction of irrigation access during construction may occur in some areas, potentially impacting livelihoods, even though the project area is mainly rainfed.	• Temporary land acquisition for construction of: • New irrigation canals (tertiary and quaternary canals) • Roads (widening of existing roads) • Hydraulic structures (dams, reservoirs) • Temporary restriction of irrigation access from existing reservoirs during construction	• Farmers • Fishers • Households along road sections • Vulnerable groups **Moderate**	The project's construction phase presents a significant risk of temporary or permanent loss of access to land and assets for local communities. Even in cases where physical resettlement is minimal, the acquisition of land, particularly along construction road, and main canals, can disrupt farming activities, restrict access to water resources, and business impacting the livelihoods of those affected. Temporary restriction of irrigation access during construction is anticipated, particularly from farming activities along Ou Ta Paong River, feeder canals, main canal existing reservoirs. This will affect income generation for farmers reliant on irrigation, and business along the canals.	Direct	- Once risks and impacts have been minimized or reduced, mitigate through compensation payment for affected assets and income generation activities. - Where land acquisition impacts remain, compensate people as per the project's LARPF. - Prioritize public land acquisition. If not feasible, acquire private agricultural land, which is anticipated to be small-scale at the household level due to linear land impact. - Avoid impact on land collectively owned by IP communities through alternative designs. - Conduct a thorough assessment of the project area's habitats to identify potential impacts on local flora and fauna. - Establish construction exclusion zones around sensitive habitats to prevent disturbance. - Implement habitat restoration programs in areas where construction has occurred.

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
Loss access to natural resources: Construction activities and project operations can restrict communities' access to forests, fishing grounds, water sources, or other natural resources they depend on for livelihoods	• Upgrading of existing reservoirs. • Construction of new dams. • Implementation of river training measures. • Temporary restriction of water access from existing reservoirs during construction.	• Farmers • Fishers • Downstream communities **Moderate**	Farmers along main streams of Ou Ta Paong and Lum Hach and feeder canals in Ou Ta Paong will face the issues. Additionally, the influx of construction workers and the establishment of temporary facilities like worker camps could put pressure on local resources, including water sources and forest products, potentially leading to exploitation and environmental degradation.	Direct	- Develop a water management plan: To minimize waterbody alteration during pre-construction activities and implement efficient water management practices to prevent over-extraction and ensure equitable water distribution during the operational phase of the project. - Develop and implement a waste management plan: To ensure the safe disposal of hazardous and non-hazardous waste generated during the project - Engage with local communities and authorities: To understand and address concerns about potential impacts on natural resources, ensuring that project design and implementation minimizes disruption to existing livelihoods. This should also include awareness campaigns to inform workers about the importance of protecting natural resources and respecting local customs and traditions. - Develop and implement a plan to manage the influx of workers: This plan should include providing workers with information about local resources, rules, and regulations, monitoring worker activities to ensure compliance, and providing alternative options for water and other essential resources.
CROSS-CUTTING					

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
Social inequality: • Risk of being unequally engaged and treated, during the design phase and construction. The vulnerable are likely to be limitedly consulted and having limited access to available irrigation water.	• Engagement and consultations during system design and construction	• Vulnerable groups/ **Moderate**	The focus group discussions confirmed that the landowners of project areas in all command areas are mainly local communities, giving similar access capacity to the consultation process. However, the field survey reported that the vulnerable are generally those who have no farmland, giving them limited access to benefit from the rehabilitated system. There are arguments at provincial and district level regarding the effort given to the poor which may end up limited efficiency and effectiveness due to lack of various resources and capacity in making the support reach its full potential. The scale of the impact is minimal due to the proportion of the poor is quite small at the command area. However, the poor may benefit from the system as some of them own a small piece of land at home for gardening.	Direct and indirect, and short and long term	- Conduct participatory planning and regular consultations with local communities, particularly marginalized groups (e.g., women, smallholder farmers, indigenous communities). - Prioritize hiring local labor, with special provisions for disadvantaged groups (e.g., youth, women, minorities) in both skilled and unskilled positions. - Develop and enforce water allocation plans that ensure fair access to water resources for all users, including small-scale and subsistence farmers, during and after construction. - Implement fair and transparent compensation or resettlement plans for those displaced or affected by construction activities, especially vulnerable households. - Establish accessible and responsive grievance redress mechanisms, ensuring all community members can raise concerns or complaints during construction. - Conduct regular social impact assessments, with a focus on identifying inequality trends, and adjust project strategies to mitigate negative effects. - Provide support and training for affected communities to diversify their livelihoods, especially for those whose livelihoods may be disrupted by construction (e.g., farmers, traders).

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					- Ensure transparency in the contracting process, including the selection of subcontractors and suppliers, with opportunities for local businesses, especially those run by marginalized groups.
Elite capture • The rich have the resources to grab both available land and water resources, creating greater social disparities	• Engagement and consultations during system design and construction	• Vulnerable groups/ **Moderate**	Since the landowners within the command areas are primarily from the local community, it is unlikely that elite land capture will occur. Additionally, the current high land prices make it unaffordable compared to the investment cost, reducing the incentive for such practices. However, there is a possibility that the wealthy may attempt to encroach upon protected areas, using their power, networks, or resources to seize land. While this is unlikely given the government's current commitment in its new mandate, if it does happen, the impact could extend to the regional level.	Direct and indirect, and short and long term	- Consultation will be conducted farmers in potential command area, focusing on vulnerable/disadvantaged groups - Alternative livelihoods for vulnerable group are identified based on their needs vis-à-vis project's investment eligibility - Conduct consultation at community level (in the command area) to achieve a consensus on how water needs are balanced between different groups in one command area. - During subproject design, water availability, storage capacity, and water needs of upstream and downstream population are calculated to inform design, and water use coordination during project operation. - Water user groups should be established for upstream and downstream population and should be coordinated by a higher-level committee/group to negotiate and optimize water coordination - Guidelines/Manual should be developed to provide guideline for upstream and downstream

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
					communities at subprojects to meet, discuss, and achieve consensus on how water is distributed for equal use between upstream and downstream population
DURING OPERATION					
COMMUNITY HEALTH AND SAFETY					
- Farmers and other labour directly involved in using chemicals inputs for crop production may be affected in terms of health (long-term) due to potential a) increased use of chemical inputs (e.g. pesticide) which affects them directly through inhalation, and through secondary sources such as contaminated surface/ underground water and produced crop. - People who consume water provided by water supply stations extracting water sources contaminated with chemical agricultural inputs may also be affected in the long run. - People who extract surface water, and underground water (through wells) that are infested with pesticide may also be affected in terms of health in the long run. - Consumers of farm produce with pesticide residue may also be affected consumers' health in the long run.	• Intensifying farming activities • Irrigation system operation	• Farmers • Local community/ **Moderate**	According to the field survey of ESCIA, it is reported that the proportion of safe practices for farmers in their pesticide application is still a concern, given only 48%, 48%, 19%, and 61% of them wears close-toed shoes, long clothes which cover skin, goggle, and gloves, respectively. The figure indicated limited understanding of pesticide affecting their health condition. Since the availability of the irrigation water and the promotion of intensification of agriculture, the application of chemical fertilizers and pesticides are likely to increase over time and will directly affect the community health as well as water quality along the stream carrying them to downstream water users and the agricultural produce users. Limited concerns were reported regarding the utilization of	Direct, indirect, cumulative	- Implement Simplified IPM Plan

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
			pesticides and fertilizers, especially with wet season rice (Lum Hach and Stung Krang Ponley). However, the concern was more at Ou Ta Paong, but their concerns are more on water shortage rather than the issues, indicating their limited awareness regarding pesticide usage.		
CROSS-CUTTING					
Gender inequality • The risk during the operational phase of the project is that women may be excluded from the benefits and opportunities, despite the project's intention to promote gender equality.	• Limited access for women to training, resources, and decision-making processes related to irrigation and agriculture.	• Women farmers and laborers	The risk is rooted in pre-existing gender inequalities in Cambodia, where women have less access to resources, technology, and decision-making power. The assessment has shown that women are less resilient to climate change than men, and they face specific vulnerabilities in terms of income, housing, and access to information and support systems. Socially determined gender roles can also impact the adoption of climate-smart technologies. Consequently, these factors could lead to unequal access to water resources, limited participation in FWUCs, and a disproportionate burden of negative impacts on women's livelihoods.	Direct and Indirect	- The project should actively encourage women's participation in the formation of FWUCs, empowering them through critical decision-making roles and equipping them with the necessary skills and resources to amplify their voices. - The project should ensure that women have equal access to training programs and resources, such as land, credit, and technology. - The project should monitor gender equality indicators and should make adjustments as needed to ensure that women are benefiting from the project.

Potential and Causes of Risks and Impacts	Key activities that cause risks and impacts	Receptor/ Sensitivity	Assessment of Risks and Impacts	Extent	Proposed Mitigation Measures
Social inequality • Risk of being unequally engaged and treated, during the design phase and construction. The vulnerable are likely to be limitedly consulted and having limited access to available irrigation water at the operation stage.	• Competition for water resources among different user groups (farmers, communities, industries). • Potential displacement or restricted access to land due to irrigation infrastructure expansion. • Engagement and consultations during system design and construction	• Farming communities • Indigenous populations (if present). • Landless or land-poor households. • Vulnerable groups/ . **Minor**	The focus group discussions confirmed that the landowners of project areas in all command areas are mainly local communities, giving similar access capacity to the consultation process. However, the field survey reported that the vulnerable are generally those who have no farmland, giving them limited access to benefit from the rehabilitated system. There are arguments at provincial and district level regarding the effort given to the poor which may end up limited efficiency and effectiveness due to lack of various resources and capacity in making the support reach its full potential. The scale of the impact is minimal due to the proportion of the poor is quite small at the command area. However, the poor may benefit from the system as some of them own a small piece of land at home for gardening.	Direct and indirect, and short and long term	- Ensure Equitable Water Access: Mechanisms should be in place to support vulnerable and marginalized communities in accessing water resources. - FWUCs will manage the irrigation systems and ensure sustainability through fee collection. The project will invest in establishing and training FWUCs, emphasizing inclusivity and capacity building for vulnerable groups. - Implement a Simplified Integrated Pest Management (IPM) Plan.

4. Environmental Monitoring Program

4.1 Environmental Monitoring Program

Summary of the Environmental Monitoring program is shown in Table below:

Table 14: Environmental monitoring plan

Monitoring Parameters	Monitoring Indicators	Location	Measurements	Frequency	Responsibility
	During construction phase				
	ENVIRONMENTAL				
Noise	• Avoid working during night-time from 21:00 hours to 06:00 hours • Provide ear sets for workers to prevent noise if the noise level exceeds the standard • Check and maintain construction machinery regularly to avoid noisy and high vibration • Restrict use of vibrating rollers and operation of heavy equipment near sensitive structures	Construction site Nearby sensitive structures	Site inspection Visual observation	Daily	SEO E&S specialist consultants PMU
	• Measuring noise and vibration level	Construction site, there are 8 locations for noise and vibration level sampling.	Measuring equipment and/or appropriate monitoring methods	Every 06 months	SEO E&S specialist consultants PMU
Air quality	• Spray or sprinkle water on the work surfaces and other piled materials to minimize dust at least 3-6 times per day in windy and dry weather and/or based on the weather condition • Solid waste or construction waste activities • Construction machinery operation and maintenance • Distance of sitting concrete mixing plants, crushing • plants, quarries and other facilities to settle and other sensitive receptors	Construction site	Site inspection Visual observation Monitoring equipment and/or appropriate monitoring methods	Daily	SEO E&S specialist consultants PMU

Monitoring Parameters	Monitoring Indicators	Location	Measurements	Frequency	Responsibility
	• Transportation of construction materials				
	Testing air quality (NO2, SO2, CO, TSP, PM10, PM2.5)	There are 8 locations for air quality sampling.	Air quality monitoring equipment	Every 06 months	
Water Quality	• Wastewater management • Design and capacity of septic tank • Digging of side drain at campsite • Construction of retaining structures	Construction site	Site inspection Visual observation	Daily	SEO E&S specialist consultants PMU
	• Testing surface water quality (Depth, pH, EC, AS, Cd, Pb, TN, TP, TDS, TSS, DO, and Total Coliform) and pesticide residues in water to be conducted overseas	There are 8 locations for surface water quality sampling.	Water quality monitoring equipment	Every 06 months	SEO E&S specialist consultants PMU
Soil quality/ quality reduction	• Avoid construction activities in the rainy season and/or days of heavy rains. • Management activities of fuel, oils, and chemical substances. • Cover all restored areas with topsoil and re-vegetate	Construction site	Site inspection Visual observation	Daily	SEO E&S specialist consultants PMU
	• Testing of soil quality is going to be analyzed in the agriculture context: - Soil classification or particle size, - Soil moisture, - Nitrogen (N), Phosphorus (P), Potassium (K), Magnesium (Mg), Sodium (Na), - Organic Metter - Ratio of the mass of carbon to the mass of nitrogen in organic residues (C/N Ratio), - Total phosphorus (P), - Cation exchange capacity (CEC), - pH, • Electrode Conductivity.	There are 5 locations for soil quality sampling.	Soil quality monitoring equipment	Every 06 months	SEO E&S specialist consultants PMU

Monitoring Parameters	Monitoring Indicators	Location	Measurements	Frequency	Responsibility
Solid waste/wastewater	• Solid and liquid waste management plan in the project construction sites. • Install septic tanks at the construction camp to prevent the discharge of polluted sewage into the outside. • Implement waste segregation of reusable construction materials, biodegradable, and non- biodegradable wastes. • Orient workers on the solid waste segregation system and prohibit them from indiscriminate throwing wastes outside of waste bins in the construction sites. • Provide sufficient waste bin and proper storage before transportation to dispose at an authorized landfill.	Construction site	Site inspection Visual observation	Daily	SEO E&S specialist consultants PMU
Hazardous and non-hazardous waste	• Hazardous and Non-hazardous waste management strategies • Sludge management • Fuel storage tank will be provided with retention areas to contain accidental spills.	Construction site	Site inspection Visual observation	Daily	SEO E&S specialist consultants PMU
	BIODIVERSITY				
Habitat Loss and Fragmentation	• Area of habitat lost or fragmented. • Changes in vegetation cover. • Number of isolated habitat patches • Presence of wildlife corridors.	Construction site	Site inspection Visual observation GIS analysis (if available) Drone surveys (if available)	Daily/Weekly	SEO E&S specialist consultants PMU
Loss of biodiversity and ecosystem services	• Changes in species abundance and diversity • Decline in water quality • Changes in soil fertility • Reduced pollination services • Alterations in hydrological processes	Construction site	Site inspection Visual observation Biodiversity surveys	Daily/Weekly	SEO E&S specialist consultants PMU
Hunting and trading, and consumption of	• Avoid cutting of trees or destruction of vegetation • No hunting, fishing, or collection of animal and plant materials	Construction site	Site inspection Visual observation	Daily/Weekly	SEO E&S specialist consultants

Monitoring Parameters	Monitoring Indicators	Location	Measurements	Frequency	Responsibility
wildlife	• Revegetation success will be monitored, particularly surrounding riparian vegetation along area where levee is installed for flood protection and for increased water retention.		Community interviews		PMU
Loss of fauna and flora	• Number of individuals of each species observed • Presence of endangered or threatened species • Changes in plant community composition	Construction site	Site inspection Visual observation Biodiversity surveys	Daily/Weekly	SEO E&S specialist consultants PMU
Destruction of farming ecosystem	• Area of farmland affected • Changes in crop yields • Impacts on livestock • Pollution of water sources used for irrigation	Construction site	Site inspection Visual observation Interviews with farmers	Daily/Weekly	SEO E&S specialist consultants PMU
Landscape and biodiversity	• Adopting good housekeeping and good construction practices. • Ensuring proper lining of canals and adequate assembling of pipes • Adopting slope stabilization techniques. • Implementing Biodiversity Action Plan (BAP)	Construction sites	Site inspection Visual observation	Daily	SEO E&S specialist consultants PMU
Protected Areas	• Exclude subproject located in the community forestry, and Zone 3 of the protected area.	Construction sites	Site inspection	Daily	SEO
GHG emission	• Monitor the amount of fuel used by construction vehicles, heavy machinery, and generators. • Track the fuel efficiency of these machines to identify opportunities for improvement. • Assess the effectiveness of measures to control dust emissions from construction sites. • Monitor the types and quantities of waste generated and their disposal methods. • Track the amount of waste recycled or reused to reduce emissions associated with landfill disposal. • Monitor the number and types of vehicles entering and	Construction site Nearby sensitive structures	Site inspection Visual observation Consultation	Daily	SEO E&S specialist consultants PMU

Monitoring Parameters	Monitoring Indicators	Location	Measurements	Frequency	Responsibility
	leaving the construction site. • Track the efficiency of transportation methods used to deliver materials and equipment.				
	During operation phase				
Water Quality	Testing surface water quality (Depth, pH, EC, AS, Cd, Pb, TN, TP, TDS, TSS, DO, and Total Coliform) and pesticide residues in water (to be conducted overseas)	There are 8 locations for surface water quality sampling.	Site inspection Visual observation	Annually	SEO E&S specialist consultants PMU
Soil quality/ quality reduction	• Testing of soil quality is going to be analyzed in the agriculture context: - Soil classification or particle size, - Soil moisture, - Nitrogen (N), Phosphorus (P), Potassium (K), Magnesium (Mg), Sodium (Na), - Organic Metter - Ratio of the mass of carbon to the mass of nitrogen in organic residues (C/N Ratio), - Total phosphorus (P), - Cation exchange capacity (CEC), - pH, - Electrode Conductivity.	There are 5 locations for soil quality sampling.	Soil quality monitoring equipment	Annually	SEO E&S specialist consultants PMU
Biodiversity and Ecosystem Services	• Implementing Biodiversity Action Plan (BAP)	The entire sub-scheme	Site inspection Visual observation	Daily	SEO E&S specialist consultants PMU
Habitat Loss and Fragmentation	• Area of habitat converted for agricultural use • Changes in the size and connectivity of habitat patches • Number of isolated habitat fragments	The entire sub-scheme	Site inspection Visual observation	Annually	SEO E&S specialist consultants PMU

Monitoring Parameters	Monitoring Indicators	Location	Measurements	Frequency	Responsibility
Invasive Species	• Presence and abundance of invasive species • Area affected by invasive species • Effectiveness of control measures	The entire sub-scheme	Site inspection Visual observation Vegetation surveys	Annually	SEO E&S specialist consultants PMU
Hunting, trading, and consumption of animal from the wild	• Incidents of illegal hunting, trapping, or fishing • Presence of wildlife products for sale • Reports of wildlife consumption	The entire sub-scheme	Site inspection Visual observation Community interviews	Annually	SEO E&S specialist consultants PMU Local authorities
GHG emission	• Monitor the Knowledge, Attitude and Practices of farmers in farming activities that cause GHG emission	The entire sub-scheme	Site inspection Visual observation Consultation	Daily	SEO E&S specialist consultants PMU
	ANNUAL CROP MANAGEMENT PLAN				
Water resource efficiency	• Monitor water extraction rates from surface and groundwater sources. • Assess irrigation efficiency by measuring the amount of water applied versus the amount of water actually used by crops. • Monitor the implementation and effectiveness of water-saving irrigation methods (drip irrigation, sprinkler irrigation, AWD for rice). • Track water consumption per unit of crop yield (e.g., cubic meters of water per ton of rice produced).	Irrigation intake points Representative fields within the sub-scheme	Water flow measurements Soil moisture monitoring Crop water use assessments	Daily	PMU FWUC
Soil erosion and soil erosion risk	• Monitor soil erosion rates in different parts of the sub-scheme, particularly in sloping areas. • Assess the effectiveness of erosion control measures (contour planting, terracing, grass barriers). • Monitor soil organic matter content as an indicator of soil health and erosion resistance.	Representative fields Areas with different slopes and soil types	• Visual assessments of erosion features (gullies, rills) • Soil loss measurements	After significant rainfall events Annually	PMU Agricultural extension officers

Monitoring Parameters	Monitoring Indicators	Location	Measurements	Frequency	Responsibility
			using erosion plots or sediment traps • Soil organic matter analysis		
Nutrient application and management	• Monitor the types and amounts of fertilizers applied to different crops. • Conduct regular soil testing to assess nutrient levels and guide fertilizer application rates. • Monitor nutrient runoff from fields, especially near watercourses.	Representative fields Water sampling points near fields	• Fertilizer application records • Soil nutrient analysis • Water quality testing for nutrients (nitrogen, phosphorus)	Before and after fertilizer application Regularly during the growing season	PMU Farmers
Use and effectiveness of pesticides	• Monitor the types and amounts of pesticides used for different crops and pests. • Assess the effectiveness of pest control measures by monitoring pest populations and crop damage. • Track the incidence of pesticide-related health issues among farmers and workers.	Representative fields Pesticide storage facilities	• Pesticide application records • Pest scouting and monitoring data • Health records	Regularly during the growing season	PMU Agricultural extension officers
Pesticide residues on site soil	• Conduct soil sampling and analysis to measure pesticide residue levels in representative fields.	Representative fields Areas near pesticide storage facilities	• Soil residue analysis	Periodically (e.g., annually or before planting sensitive crops)	PMU Third-party laboratories
Pesticide residues on produce	• Collect and analyze samples of produce to determine pesticide residue levels. • Ensure that produce meets national and international	Representative fields at harvest time	• Laboratory analysis of produce	Before harvest	PMU Third-party laboratories

Monitoring Parameters	Monitoring Indicators	Location	Measurements	Frequency	Responsibility
	standards for maximum residue limits (MRLs).		samples		
Energy use	• Monitor fuel consumption for machinery and equipment used in farming operations. • Track electricity usage for irrigation pumps and other energy-consuming activities. • Assess the efficiency of energy use by calculating energy consumption per unit of crop yield.	Fuel storage facilities Irrigation pump stations	• Fuel consumption records • Electricity meter readings	Regularly (e.g., monthly or seasonally)	PMU

4.2 Social Monitoring Program

To ensure the effectiveness of social management, the social monitoring program is prepared to monitor social issues. Contractor and/or sub-contractor is responsible for monitoring using appropriate method, equipment and system. Details on monitoring parameters are shown in the table below:

Table 15: Social monitoring plan during construction and operational phase

Monitoring Parameters	Monitoring Indicators	Locations	Measurements	Frequency	Responsibility
During construction phase					
CHILD LABOR & FORCED LABOR					
Child Labor/ Forced Labor	• Involvement of child labor/ forced labor in main contractor and subcontractors' workforce • Involvement of child labor/ forced labor among primarily supply workers	• Construction sites • Worksite of primary supplier	• Site inspection • Observation	• Daily • Screening prior to engaging services of primary supplier	• Contractors • Primary supplier PMU
COMMUNITY HEALTH AND SAFETY					
Community Health and Safety	• General disease prevalence within the subproject area and neighboring areas • General health of workers • Communicable diseases among workers and the subproject community	• Construction sites • Camp site and Worker camps • Community and neighboring	• Site inspection • Observation • Consultation with workers • Consultation with local authorities and commune health	• Daily • Monthly • Within 48 hours for	• Contractors • PMU

Monitoring Parameters	Monitoring Indicators	Locations	Measurements	Frequency	Responsibility
	• Construction activities that give rise to risks related to traffic accidents and other construction related accidents including fatality, disease outbreaks, and environmental pollution incident	community	center		
Labor Influx	• Prepare Contractors' Labor Management plan	• Contractors' office • Construction sites	• Labor management plan prepared and submitted to PMU for approval (as part of Contractor's ESMP) • Total workers planned to be mobilized on-site monthly for entire subproject cycle (including managers, skilled workers and unskilled workers) • Total workers planned to mobilize and mobilize monthly (by gender, local vis-à-vis migrant)	• Before construction is proceeded • Updated as needed (subject to PMU's prior review)	• Contractors (including main contractors and subcontractors) • PMU
	• Recruitment of local labor	• Construction sites	• Number of local people engaged monthly (sex disaggregated), and included in Contractors' monthly progress report (to PMU)	• Monthly and during subproject cycle	• Contractors • PMU
	• Ensure equity and gender-based job opportunities	• Construction sites	• Total female workers mobilized on-site per month • Number of local female workers mobilized on-site per month • Number of IP workers mobilized if month (if IPs are present in subproject area)	• Monthly and during subproject cycle	• Contractors • PMU
Security and Road and Traffic safety	• Security cautions • General disease prevalence • Worker health	• Construction sites • Access roads to construction sites	• Site inspections • Incident reports • Data collection	• Daily during construction • Weekly during construction	• Contractors • PMU • Local

Monitoring Parameters	Monitoring Indicators	Locations	Measurements	Frequency	Responsibility
	• Communicable diseases	• Newly constructed/rehabilitated roads	• Consultation with workers and community members • Review of contractor safety plans	• Monthly during operation	authorities
SEA/SH	• Before mobilizing workers to construction site, conduct orientation/training on SEA/SH (using sample Code of Conduct as a minimum) for all Contractors' managers and workers mobilized to construction site • As part of the above training/orientation, ensure all workers understand SEA/SH risks, disciplines and penalty, and understand project's grievance procedures related to SEA/SH • As part of the workers and manager's work contract, require all workers engaged for project (both workers mobilized to site or work in contractors' office) to peruse and sign Workers' CoC • Ensure Contractors appoint a focal point in charge of ESHS and grievance reception, processing and resolution • Apply all measures related to management of work camps	• Construction sites • Relevant local communities	• Number and percentage of workers trained on SEA/SH prior to mobilization to subproject site • Number and percentage of workers signing Code of Conduct as part of Work Contract • Percentage of workers perpetrating SEA/SH and percentage of cases reported to PMU and resolved • Name and contact of ESHS and grievance focal report reported in Contractor's ESMP.	• Monthly and during subproject cycle • Reported to PMU within 48 hours if occurred	• Contractors • PMU
Community Health and diseases	• Incidence of waterborne diseases • Prevalence of vector-borne diseases (e.g., malaria, dengue fever) • Respiratory illnesses related to dust and air pollution • Availability and accessibility of	• Construction sites • Worker camps • Community and neighboring areas	• Health data collection • Site inspections • Health surveys and interviews • Consultation with workers and community members	• Monthly • During outbreaks • Periodic community health	• PMU • Contractors • Local health authorities

Monitoring Parameters	Monitoring Indicators	Locations	Measurements	Frequency	Responsibility
	healthcare services • Community awareness of health risks and preventative measures			awareness campaigns	
Social Conflicts	• Any actions on the part of Contractors' workers or community member that cause social conflicts (e.g. SEA/SH, the way construction activities are carried out [pollution, restricted access, loss of local income/livelihoods, accidents…)	• Construction sites • Relevant local communities	• Number of social conflicts arising and nature and scope of conflict • Number of social conflicts resolved by contractors within 7 days • Number of social conflicts resolved by local authorities • Number of serious cases that have happened and reported to PMU within 48 hours	• Daily • Monthly	• Contractors • PMU
	• Conflicts between upstream farmers who prioritize water storage for their crops and downstream farmers who require a consistent water supply for their agricultural needs.	• Local communities are living downstream and upstream.			
Land acquisition/ Economic displacement	• Track the process of acquiring land for the project, ensuring fair compensation is provided to affected landowners. • Implement programs to help displaced individuals and communities restore their livelihoods. • Establish effective grievance mechanisms to address complaints and concerns related to economic displacement.	• Construction sites	• Monitor the distribution of compensation payments and address any disputes or concerns. • Monitor the effectiveness of these programs, such as job training, income generation opportunities, and access to resources. • Monitor the responsiveness of these mechanisms and ensure timely resolution of issues.	• Daily • Reported to PMU within 48 hours	• Contractors • PMU
OCCUPATIONAL HEALTH AND SAFETY					
Physical Hazards	• Incidence of worker injuries due to physical hazards (e.g., falls, cuts, being struck by objects) • Unsafe working conditions (e.g., inadequate lighting, lack of proper	• Construction sites • Worker camps • Access roads	• Site inspections: Observe working conditions, worker behavior, and safety equipment usage. • Incident reports: Document all	• Daily during construction • Weekly safety meetings	• Contractors • PMU

Monitoring Parameters	Monitoring Indicators	Locations	Measurements	Frequency	Responsibility
	safety equipment, slippery surfaces) • Compliance with safety regulations and use of personal protective equipment (PPE)		accidents and near misses, including details of the incident, causes, and contributing factors. • Safety audits: Regular inspections to assess compliance with safety regulations.		
Chemical hazards	• Exposure of workers and communities to hazardous chemicals (e.g., pesticides, fuels, solvents) • Improper storage, handling, and disposal of chemicals • Air and water quality monitoring to detect chemical contamination	• Construction sites • Worker camps • Areas surrounding construction sites	• Site inspections: Observe chemical handling practices and storage conditions. • Air and water quality testing: Regular monitoring for chemical contaminants. • Review of material safety data sheets (MSDS): Ensure proper procedures for handling and storing chemicals. • Training for workers: Educate workers on safe chemical handling practices and emergency procedures.	• Regular inspections of chemical storage and handling areas	• Contractors • PMU
Underpaid pay and unequal treatment	• Worker wages and benefits compared to legal requirements and industry standards • Instances of discrimination or unfair treatment based on gender, ethnicity, or other factors • Access to grievance mechanisms for workers to report unfair labor practices	• Construction sites • Worker camps	• Payroll records review: Verify worker wages and benefits. • Worker interviews: Confidential interviews to gather feedback on labor conditions and treatment. • Observation of worker interactions: Monitor for signs of discrimination or unfair treatment. • Review of contractor labor policies and practices: Ensure	• Regular payroll audits • Periodic worker satisfaction surveys • Prompt investigation of any reported grievances	• Contractors • PMU

Monitoring Parameters	Monitoring Indicators	Locations	Measurements	Frequency	Responsibility
			compliance with labor laws and ethical standards.		
Loss access to land and other assets	• Number of households affected by land acquisition or temporary restrictions on land use • Types of assets affected (e.g., land, houses, crops, trees) • Adequacy of compensation and resettlement measures for affected households	• Project areas where land acquisition is required • Areas affected by temporary restrictions on land use	• Land surveys and asset inventories • Consultations with affected households • Review of compensation and resettlement plans • Monitoring of resettlement implementation	• Before land acquisition • During land • After resettlement	• Contractors • PMU
Loss access to natural resources:	• Impacts on community access to water resources (e.g., for drinking, irrigation, fishing) • Impacts on access to forests and other natural resources • Measures to mitigate impacts and provide alternative access to resources	• Areas downstream of irrigation schemes • Areas surrounding project activities that may affect natural resources	• Water quality and quantity monitoring: Assess impacts on water resources downstream of project activities. • Consultations with communities: Gather feedback on impacts on natural resource access and use. • Development and implementation of mitigation plans: Address impacts and provide alternative access to resources.	• Regular water quality and quantity monitoring • During project implementation: Monitor the effectiveness of mitigation measures.	• PMU • Relevant government agencies • Contractors
Cultural heritage	• Unexpected impacts on heritage resources	• Construction sites	• Site inspection • Observation • Report by local people/local authority	• Daily • Reported to PMU within 48 hours	• PMU • Contractors
Elite capture	• Equitable distribution of project benefits among community members • Transparency and accountability in decision-making processes • Mechanisms for community participation and feedback	• Project implementation areas • Community meetings and consultations	• Monitoring of benefit distribution: Track who is receiving project benefits and ensure fairness. • Observation of decision-making processes: Assess inclusivity	• Throughout project implementation • Regular community meetings and	• PMU • Contractors • Community representatives

Monitoring Parameters	Monitoring Indicators	Locations	Measurements	Frequency	Responsibility
			and transparency. • Community feedback mechanisms: Establish channels for communities to voice concerns and provide input.	consultations	
GRM	• All grievances shall be recorded (including verbal grievance). Grievance resolution process and resolution result and status will be updated/monitored regularly to ensure grievances are processed/resolved within the timeframe specified for each step in grievance redress procedure.	• Worker in construction sites • Community and neighboring community	• Site inspection • Observation Consultation with local authorities and local community	• Daily • Monthly	• Contractors • PMU
During operation phase					
Irrigation Operation and Maintenance	• Operation and maintenance for the subproject and irrigation system	• Within target command area • Downstream the target command area	• Inspect and evaluate system dam safety	• Monthly	• PMU (during project life) • PDWRAM (after subproject completion)
			• Prepare before construction completion and adopt during operation	• As soon as the rehabilitated dam and irrigation system is operated again	
COMMUNITY HEALTH AND SAFETY	• Number of accidents and fatalities related to construction activities • Number of disease outbreaks and environmental pollution incidents • Number of reported cases of worker health issues	• Construction sites • Camp site and Worker camps • Nearby community	• Site inspection reports • Accident/Incident reports • Medical records/reports • Consultation minutes/reports	• Daily for site inspections • Monthly for reports and consultations • Within 48 hours for reporting accidents, disease outbreaks.	• PMU • PDWRAM

Monitoring Parameters	Monitoring Indicators	Locations	Measurements	Frequency	Responsibility
CROSS-CUTTING					
Gender inequality	• Percentage of female workers in different roles (skilled, unskilled) • Number of reported cases of gender-based violence or discrimination • Participation of women in FWUCs and decision-making processes related to water management.	• Construction sites • FWUC meetings • Community consultations	• Observation of worker roles and interactions. • Records of complaints and their resolution. • Attendance records and meeting minutes.	• Monthly for data collection and reporting	• PMU • PDWRAM
Social inequality	• Employment rates of vulnerable groups (poor, ethnic minorities, people with disabilities) in project activities. • Access to project benefits (training, information, resources) among different social groups.	• Construction sites • Training sessions • Community consultations	• Employment records and beneficiary lists. • Attendance records and feedback surveys. • Consultations with community members and representatives of vulnerable groups.	• Monthly for data collection and reporting	• PMU • PDWRAM
Elite capture	• Participation and representation of different social groups in decision-making bodies (FWUCs, committees). • Transparency and accountability in the allocation of project resources and benefits. • Monitoring of complaints related to favoritism or exclusion in decision-making.	• FWUC meetings • Community consultations • Project implementation records	• Observation of meeting dynamics and representation • Analysis of resource allocation records. • Records of complaints and their resolution.	• Regularly during FWUC meetings and project implementation • Continuously through the GRM.	• PMU • PDWRAM
Water Use Conflict between upstream and downstream	• Establishment of water user groups for target command area • Development of guidelines/manual for water use coordination within target command area (upstream and downstream) • Policy actions related to water use coordination at sub-basin/basin level	• Within target command area • Downstream the target command area	• Number of water user groups to be established for the target command area • Percentage of command area (ha) that are coordinated by established water user group • Percentage of command area (ha) that benefit from water fee	• Monthly	• PMU • Established water user groups • PDWRAM

Monitoring Parameters	Monitoring Indicators	Locations	Measurements	Frequency	Responsibility
	• Ensure an effective monitoring mechanism (which is built on water user consensus) is in place, transparent, and information on water use and distribution is regularly recorded to facilitate equitable water use across the entire command area.		(contributed by water user) • Number of waters use conflicts that are reported, recorded, and resolved by affected water user group • Number of waters use conflicts that are reported to, recorded and resolved by provincial Department of Water Resources		

5. SUMMARY OF THE STAKEHOLDER ENGAGEMENT PROCESS

5.1 Stakeholder Consultation

5.1.1 Stakeholders and Purposes

Public consultation is a key component of CAISAR, and it was pivotal in preparation of the Environmental, Social, Climate Impact Assessment report (ESCA) Report and the Environmental, Social, Climate Management (ESCM) Plan. The consultations were conducted with relevant institutions, non-governmental organizations, local authorities, and local people during the preparation of ESCIA and ESCMP for CAISAR project. The data collection and consultations were conducted over four periods:

- The first consultation was conducted between 26 and 28 July 2024 to capture information regarding biodiversity and environmental condition in the project area.
- The second consultation was conducted to consult with forestry and fishery communities, local authorities and key informants to understand the situation and concerns related to the presence of the project. The consultation was conducted between 03 and 09 August 2024.
- The third consultation was conducted at household, village, and commune level stakeholders focusing on status, concerns and feedback regarding the project implementation. This consultation was conducted between 10 and 18 August 2024.
- The last consultation was conducted between 21 and 23 August 2024 with the district and provincial stakeholders, mainly focusing on the opinion, and feedback regarding the implementation of the project.

In addition to the stated consultations, there are also continuous consultations being conducted with AIIB, IFAD, and CAISAR PMU including the PMU management, SECAP team, and engineering team to ensure that the disclosed information being aligned with the most updated information of the project.

Table 16: Number of participants being consulted for the ESCIA

Levels	Household survey (Beneficiaries and Potentially Affected)	Focus Group Discussions	Key Informant Interviews	Total
Village level	272 (134 Females)	309 (180 Females)	32 (3 Females)	613 (317 females)
Commune level			35 (11 Females)	35 (11 Females)
District level			28 (10 Females)	28 (10 Females)
Provincial level			51 (12 Females)	51 (12 Females)
			Total	**727 (350 Females)**

Table 17: Types of stakeholders, and topics of the consultations is shown below:

No.	Levels	Key topics	Methods	Timeframe	Participants	Concerns
1	Village	Beneficiary Households	Household Survey	10 - 18 August 2024	A household survey was carried out to gather information from local people living in the 31 villages neighbouring the ESCIA project area.	Refer to concerns and suggestions from consulted people in section 4.1.3.1.
		Potentially Affected Households				
		Rice farmers	FGDs	10 - 18 August 2024	309 persons (129 male and 180 female)	
		Vegetable producers				
		Chicken raisers				
		Duck raisers				
2	Commune	Commune Committee for Women and Children	Key Informant Interviews	26 - 28 July 2024 03 - 09 August 2024	31 persons (20 male and 11 female)	
		Agricultural Cooperatives				
		Water Farmer User Community				
		Fishermen				
		Community Forestry				
		Community Fishery				
3	District	Offices of Development and Planning, Agriculture, Environment, Women Affairs,	Key Informant Interviews	21 - 23 August 2024	28 persons (18 male and 10 female)	
4	Province	Provincial Hall, Departments of Land, Water, Agriculture, Environment, Women Affairs, Labour, and Culture	Key Informant Interviews	26 - 28 July 2024 21 - 23 August 2024	51 persons (39 male and 12 female)	

5.1.2 Consultation Process

The purposes of the consultation were to:

- Inform local people and interested stakeholders of the purpose of the rehabilitation and construction of the irrigation system,
- Share the project information and the design options from the draft engineering design,
- Highlight subproject's key activities that potentially associated with them, and

- Collect their opinion, concern and feedback on the project focusing on background information, project potential impacts (positive and negative), suggestions for impact mitigations, and consultation mechanism.

The consultation agenda with stakeholders included (i) the introduction of the study team, (ii) sharing project information using illustration materials, (iii) discussion and consultation on potential benefits and impacts of the project, (iv) suggestions on the mitigation measures, (v) grievance process and concerns, and (vi) final wrap up for the consultation. The study team were trained to introduce themselves about the purpose of the consultation, followed by the introduction about the project's component and activities expected to be implemented within the area. Materials including leaflet on project information and map of the command area were shared and explained to stakeholders prior to the consultation. Lastly, the consultation began with an overall discussion and specific questions as per the relevant aspect to the stakeholder. Opinions, concerns and suggestions were gathered and confirmed prior to the end of the consultation.

5.1.3 Results of the Consultations

The result of the consultation is presented below summarizing what the consulted stakeholders perceived about the project, their concerns on the risks and impacts, and their feedback and suggestions to which the project should be taken care of. The results of the consultations include general opinions, concerns and feedback on the project of stakeholders from focus group discussion, village leaders, commune councils, district authorities, provincial line departments, and provincial governments. The results from the consultations were also included in Chapter 06, and Chapter 08 to which they have been responded in the mitigation measures of the project. The synthesized results of the consultation are presented as per the identified VECs below.

5.1.3.1 Environment and Biodiversity Component

a) Pollution prevention and resource efficiency

Concerns

- The rehabilitation of irrigation canals and farm roads can disturb environmental effects.
- Large machines can generate noise and vibration pollution, which can disturb nearby residents and wildlife.
- The disposal of solid, liquid, and domestic waste from the workers at the irrigation construction site can negatively impact local air quality and surface water.
- During the construction stage, such as the rehabilitation of irrigation canals and farm roads, can have disturbing environmental effects.
- The construction process can release dust, which will disturb the local community and surface water quality.

Suggestions from the consulted people

- Avoid construction at night.

- Install garbage bins and waste storage areas in the construction sites and conduct orientation workers to put the waste in the garbage bins.
- Government institutions and stakeholders should regularly conduct site to inspect project activities that harm the environment and local community.
- Relevant ministries should conduct a visit to evaluate and address the issue of liquid waste from the construction activities in the commune.
- Regularly watering on the road transports construction materials and soil to reduce dust that may disturb nearby residents.

b) Biodiversity

Concerns

- CAISAR project may cause negative impact on the environment, including changes in water quality, dust generation, air pollution, soil erosion, improper waste disposal, and hazardous waste from machinery.
- The project could disrupt the natural flow of water from upstream to Tonle Sap Lake, potentially harming the lake's biodiversity.
- Fish populations in command areas may decrease due to disrupting the natural flow of water and the impact on their habitats from the implementation of the reirrigation infrastructure and canal upgrading.

Suggestions from the consulted people

- The contractors and relevant parties should conduct water quality and air quality monitoring during construction.
- Contractors must regularly monitor and inspect the living conditions of the workers, manage waste effectively, and provide adequate housing and sanitation facilities to them.
- Providing comprehensive training to workers on proper waste and oil management procedures.
- Activities such as fishing and hunting should be strictly prohibited to minimize environmental impact.
- The project should avoid construction activities and improve irrigation on fish and aquatic habitats.
- Prevent damage from the construction activities to biodiversity, habitats, and other environmental components.
- The project should avoid construction activities and improve irrigation on fish and aquatic habitats.
- Maintain existing large trees along the dam and canal within the sub-schemes during the reirrigation and upgrading process.

c) GHG Emission

Concerns

- Climate change is negatively impacting rice production, causing problems such as insect infestations, and extended dry seasons,
- Waste and pollution may contribute to the emission of GHG

Suggestions from the consulted people

- The contractors should ensure that garbage bins are conveniently placed throughout the workers' camp and collaborates with a waste collection company to guarantee regular and efficient removal of waste.
- To minimize emissions, contractors are advised to refrain from using outdated machinery.
- Installing solar water pumps in agriculture processing facilities can reduce fuel consumption, which causes greenhouse gas emissions.

5.1.3.2 Social Component

a. Labor and Working Conditions

Concerns

- The presence of construction staff and workers at the community may lead to sexual exploitation or affecting women workers and women and children in the community.
- At the construction sites, some men may undervalue women's work. The gender disparities continue to exist, with some men holding the belief that women are not capable or willing to work.
- Under 18 years old workers may be involved for the construction phase as they are illegible to work in factories or other companies that adhere to laws,
- At the construction sites, some men may undervalue women's work. The gender disparities continue to exist, with some men holding the belief that women are not capable or willing to work.

Suggestions from the consulted people

- The construction companies should hire local workers to offer them jobs and strictly abide to laws and reducing the concerns about gender-based violence or sexual violent.
- Construction companies and relevant departments should provide training on gender issues, violence, labour laws, and social protections to their staff and workers.
- The project should allocate budget for relevant line departments to conduct relevant trainings to the companies and workers, and to monitor the construction sites
- Additional support and monitoring measures should be put in place to prevent abuse, with any incidents being promptly addressed to avoid recurrence.

- Local authorities should regularly inspect construction sites to ensure no children are employed, taking immediate action if any issues are identified.

b. Community Health and Safety

Concerns

- Participants remain concerned that the presence of workers could result in sexual abuse of women and children living near the project site.
- Drug trafficking and consuming among workers may cause unsafe environment for both workers and surrounded residents.
- The construction activities may generate dust and slippery road conditions which may lead to traffic incidents.
- Waste generated from worker camps and construction activities during the project could degrade water quality, negatively impacting human health, livestock, and crops.
- After construction is completed, there may be risks of people and animals falling into the canals, potentially leading to drowning incidents.

Suggestions from the consulted people

- The construction companies should regularly place warning signs and water the roads, as well as schedule construction times to minimize noise pollution that could disrupt the community,
- The project should promote gender awareness, enforce stricter punishments for offenders, and prevent drug trafficking in the workplace,
- The construction companies must collaborate with local authorities in all activities to make a proper management, control and monitoring during construction, and
- The project should conduct gender education at the district to prevent and address gender-based violence.
- Separate accommodations for men and women should be provided.
- The project should establish gender outreach committees at the commune and village levels to monitor gender-related issues within the project areas, particularly during construction.
- The project should equip the solar lights along the roads to promote the safety of travellers during nighttime.

c. Land acquisition, economic and physical displacement

Concerns

- While the project supports agricultural production, it may not benefit poor families who do not have land for farming.

- Conflicts between the project and affected families may arise, often driven by external influences rather than the families themselves.
- Land-owning farmers might lose their land for agriculture, which could compel them to migrate.
- Landowners along the irrigation system without proper land registration are concerned they may not receive compensation due to the lack of title deeds.

Suggestions from the consulted people

- The government is requested to assist in issuing land titles to farmers with land adjacent to streams and canals.
- The project should conduct a preliminary study on land issues before construction is going to be implemented, addressing specific aspects of land impact and conducting evaluations for each affected property,
- While the project supports agricultural production, it may not benefit poor families who do not own land for farming.
- The project/construction company must collaborate with local authorities to resolve land-related issues, and compensation should be provided to landowners affected by the project,
- Land-owning farmers could lose their land, potentially forcing them to migrate, increasing their vulnerability to exploitation and potentially causing their children to drop out of school.
- The construction company should submit quarterly monitoring reports on implementation activities to the provincial department to identify and quickly resolve any issues.
- Conflicts between the project and affected families may arise, often instigated by external parties rather than the families themselves.
- If business land is impacted, the government or provincial authorities should provide temporary business premises,
- Advocacy for voluntary land contributions should be encouraged, as the project benefits both the community and individuals, and the restoration of old canals is supported to improve agricultural activities

d. Cross–cutting risks and impacts

Concerns

- Unequal water distribution among farmers leads to conflicts.
- Institutions or companies responsible for establishing FWUCs are typically based at the national level, resulting in limited quality implementation weakening the FWUCs as PDWRAM is sidelined.
- The FWUCs struggle to generate income, making water management challenging, as there is no budget for repairs, leading to improper system operations.

- Farmers face various challenges such as pests, diseases, labor shortages, lack of capital, limited production techniques, flooding, unstable prices for vegetables and livestock, and high agricultural input costs.
- The provincial department lacks the budget to support the resolution of water user conflicts.
- Some farmers are absent from the rice fields during water distribution periods.
- Tensions between upstream and downstream villages arise when excess water released upstream during the wet season causes downstream flooding, while in the dry season, insufficient upstream water flow impacts downstream areas.
- High agricultural input costs continue to reduce farmers' profitability.
- Farmers do not follow official guidance on the size of rice fields to be cultivated, leading to inadequate water for irrigation.
- Construction companies might disregard concerns raised by local authorities and communities regarding the actual conditions of the area.
- Manure for fertilizer is declining due to reduced animal raising and lower cattle prices are prompting farmers to reduce livestock raising.
- Farmer Water User Group (FWUG) is not well-functioning.

Suggestions from the consulted people

- A proper handover to local authorities upon project completion should be conducted to avoid quiet handovers,
- Women should be engaged and be promoted as the members of Water User Community to promote water distribution equality regarding water allocation from the system,
- PDWRAM should be the leader in formulating the FWUCs with the support from national level,
- Water use and maintenance support should be provided including technical and management training, along with problem-solving techniques, to effectively control and manage water distribution.
- The project should thoroughly examine the water availability, technical and situational aspects of the sub-scheme before construction to prevent water shortages or flooding.
- Providing technical and management training, materials supported to existing Farmer Water User Group (FWUG) to oversee water use and maintenance effectively control and manage water distribution regularly by all levels.
- Ensure transparent water supply to prevent disputes by holding meetings to plan water use and distribution, involving the district governor, commune council, and relevant stakeholders.

- All parties should also participate in the maintenance of the irrigation system and provide training or education on water conservation to farmer.
- Prior to starting irrigation rehabilitation, disseminate project information to people and stakeholders, and announce the construction period in advance.
- The water consumption fee should be gathered from farmers which could be used later to support caretaker and maintenance the irrigation system.
- Increase the number of commune agricultural technical officers to provide training and monitor farmers' cultivation techniques.
- Build more water storages, and reservoir such as ponds or wells and conduct training on water-saving techniques to adapt to actual water availability.
- Installing and upgrading the damaged sluice gates to improve water distribution efficiency and prevent water loss in agricultural production and irrigation systems.
- Facilitate the development of additional agricultural markets.
- Providing modern equipment and new techniques to department officers can enhance agricultural production efficiency and yield.
- Restore the Brambei Mom dam to its original height to improve water storage capacityand Stueng Krang Ponley with its sub-canal to improve water distribution.
- Improving the Anlong Chrey Reservoir and upgrading the sluice gate can help prevent flooding and better manage water resources.
- Utilizing durable concrete for the canal system can improve the efficiency and longevity of the irrigation infrastructure.
- Installing and upgrading damaged sluice gates in both main and secondary canals can improve water distribution efficiency and prevent water loss in agricultural production and reirrigation systems.
- Construct both side roads along the canal to enhance transportation for farmers and traders.
- The project should thoroughly examine the technical and situational aspects of the sub-scheme before construction to prevent water shortages or flooding post-construction, and it should be implemented promptly.