

Initial Environmental Examination: Summary

November 2012

REG: Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project

Prepared by the Ministry of Water Resources and Meteorology for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 8 November 2012)

| | | |
|---------------|---|-------------|
| Currency unit | | riel/s (KR) |
| KR1.00 | = | \$0.00025 |
| \$1.00 | = | KR4,047.95 |

ABBREVIATIONS

| | | |
|--------|---|--|
| ADB | – | Asian Development Bank |
| CPMU | – | central project management unit |
| FWUG | – | Farmer Water Users Group |
| FWUC | – | Farmer Water Users Committee |
| ha | – | hectare |
| IEE | – | Initial Environmental Examination |
| km | – | kilometer |
| mm | – | millimeter |
| MOWRAM | – | Ministry of Water Resources and Meteorology |
| PDWRAM | – | Provincial Department of Water Resources and Meteorology |
| UXO | – | unexploded ordnance |

NOTE

In this report, "\$" refers to US dollars.

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I. INTRODUCTION

1. The objectives of the proposed Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project (The Project) will be improved preparedness to manage and reduce the impacts of flood and drought events in the subregion including reducing economic losses and fatalities. The project outcome will be improved capacities and preparedness to manage and mitigate the impacts of flood and drought events. The project outputs will be: (i) enhanced regional data, information and knowledge base for the management of floods and droughts; (ii) upgraded water management infrastructure; (iii) enhanced capacity for community based disaster risk management (CBDRM); and (iv) effective project implementation.

2. The Damnak Chheukrom Irrigation scheme was built in Pol Pot regime, Khmer Rouge about 30 years ago. Since then this system has not been ever rebuilt or rehabilitated. The proposed Project aims to minimize the impacts of floods in Pursat town by diverting peak flood flows through the rehabilitation of head-works, main and secondary canals, building riverbank protection and by increasing climate resilience through capacity building of Farmer Water Users Communities (FWUCs) and affected communities in agricultural adaptation techniques, flood and drought management and preparedness, promoting community-based disaster management and reduction, and provision of better flood and drought forecasting and early warning system. Rehabilitation of main and the secondary canals will improve the supplementary irrigation of 16,000 ha during the wet season.

3. The Project is classified as environmental category B in accordance with 2009 Safeguard Policy. Initial Environmental Examination (IEE) was carried out for the scope of the rehabilitation of the Damnak Chheukrom Irrigation scheme.

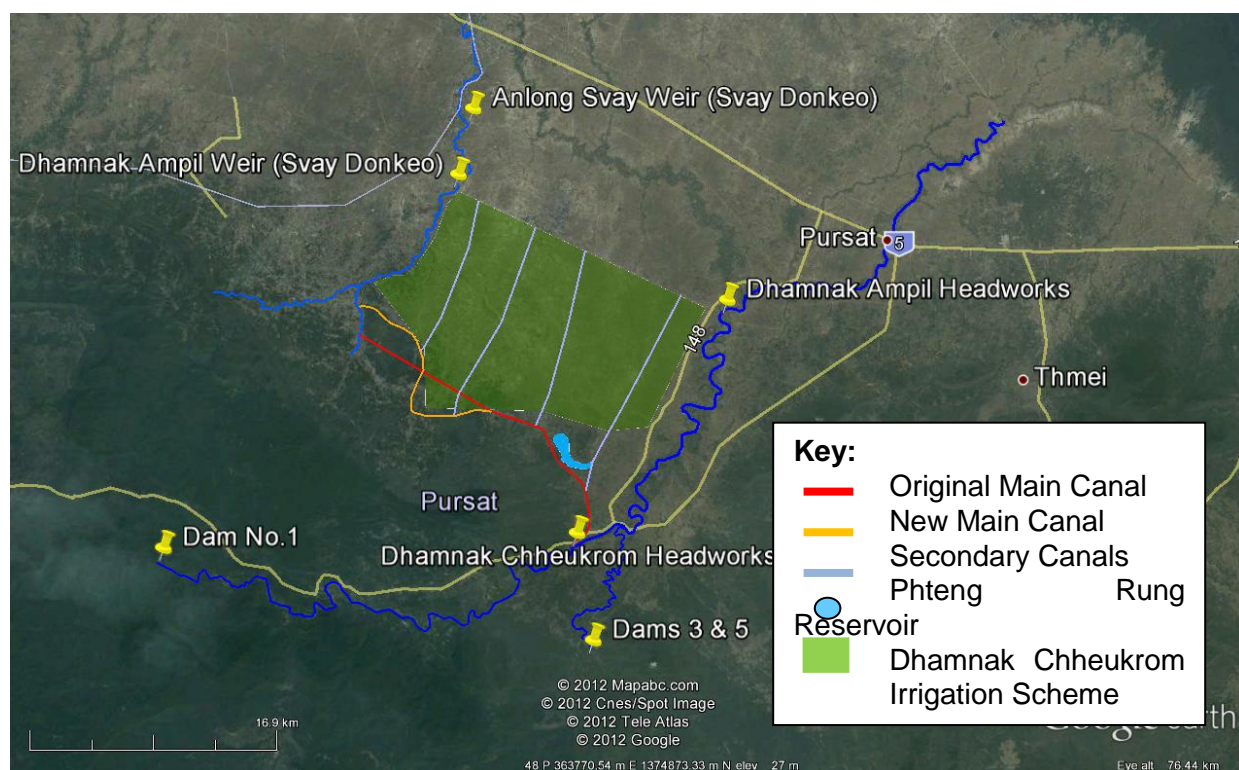
II. DESCRIPTION OF THE PROJECT

4. Table 1 presents the summary of investment work while Figure 1 shows the layout of the Damnak Chheukrom Irrigation scheme.

Table 1: Scope of Investment Work

| | Main Components | Main Activities |
|---|---|--|
| 1 | Irrigation System Components | <ul style="list-style-type: none">• Rehabilitation of diversion structure (Barrage structure with 50-year design flood (1,160 m³/s) under anticipated climate change conditions, intake structure with 40 m³/sec diversion capacity) from the Pursat river to Stueng Svay Doun Kaey• Rehabilitation of a main canal (30 km)• Rehabilitation of 4 secondary canals (12-14 km each)• Construction of associated structures• Construction of traditional field reservoirs to integrate into the• Drip irrigation systems |
| 2 | Capacity building of Farmer Water Users Communities (FWUCs) and community disaster management | Formation of/or capacity building of existing FWUCs to manage the irrigation infrastructure and to be the anchor for community based flood and drought management |

Figure 1: Damnak ChhoeKrom Irrigation Project in Pursat Province



III. DESCRIPTION OF THE ENVIRONMENT

5. **Pursat Subbasin.** Stung Pursat River originates from the Cardamom Mountains and flows into Tonle Sap Lake from southwestern direction. Pursat river consists of three main tributaries and comparatively wide upstream mountainous area and narrow middle stream catchment area. Catchment area of Stung Pursat River Basin is about 5,965 km². The upper Pursat River basin consists of three tributary basins-Pursat, Arai (Peam) and Prey Khlong River basins. Annual rainfall in the Pursat river basin is about 1,400 mm per year. The rainy season lasts from June to November and causes recurrent floods in the area. On the other hand, severe drought problems happen during the rest of the year including the dry season. Boeng Preah Punley reservoir is located in the Phtenh Rung commune and is currently used as storage to irrigate a small area downstream during the dry season irrigation.

6. Severe flooding in 2011 resulted in damage to over 17,000 ha of rice, moderate damage to 29,000 ha of rice and 519 ha of casava, mungbeen and vegetables. In addition, the 2011 flooding caused submergence of over 10 km of rural road and dozens of schools and hospitals, affected 13,000 families, and loss of 10 human lives across Bakan, Kandeang and Krakor districts (PCDM, 2011). Economy and people's livelihood mainly depends on agriculture predominated by rice cultivation. The Pursat province is one of the poorest provinces in the country, and drought and floods in the Stung Pursat River Basin have made the situation worse over the years. Construction of two reservoirs (Dam No. 3 and Dam No. 5) on the Stung Peam tributary is proposed in the upstream of the Pursat River to supply water for dry season.

7. **Water Quality.** The project preparatory technical assistance (PPTA) study team collected the secondary data on the surface and groundwater quality data shown in Table 2, 3 and 4. The surface and groundwater quality in Stung Pursat basin area is generally good except for the concentration level for Total Suspended Solids and iron that exceeds the drinking water standards at some sample sites.

Table 2: Surface Water (SW) Quality in Pursat River

| Parameter | Unit | SW1 | SW2 | Protected public water area standard | Public water area and sewer standard |
|--------------|------|--------|--------|--------------------------------------|--------------------------------------|
| pH | | 6.51 | 7.03 | 6-9 | 5-9 |
| TDS | mg/l | 53.5 | 31.8 | < 1000 | < 2000 |
| TSS | mg/l | 61.2 | 24.2 | < 50 | < 80 |
| DO | mg/l | 5.4 | 6.6 | >2.0 | >1.0 |
| Oil & Grease | mg/l | 1.2 | 0.35 | < 5.0 | < 15 |
| Hardness | mg/l | 12.3 | 21.4 | - | - |
| Nickel | mg/l | 0.006 | 0.004 | < 0.2 | < 1.0 |
| Copper | mg/l | 0.010 | 0.022 | < 0.2 | < 1.0 |
| Zinc | mg/l | 0.167 | 0.167 | < 1.0 | < 3.0 |
| Arsenic | mg/l | <0.001 | <0.001 | < 0.10 | < 1.0 |
| Cadmium | mg/l | <0.001 | <0.001 | < 0.1 | < 0.5 |
| Lead | mg/l | 0.004 | 0.003 | < 0.1 | < 1.0 |
| Iron | mg/l | 4.12 | 1.76 | < 1.0 | < 20 |
| Mercury | mg/l | <0.001 | <0.001 | < 0.002 | < 0.05 |

Source: Ministry of Environment and PGS Asia pacific Ltd. 2008.

Table 3: Baseline Survey Sampling Locations in Pursat Province

| Sample | District | Commune | Location | Lat | Long |
|---------------------|---------------|---------------|-------------------------------------|------------|-------------|
| Surface water - SW1 | Kandieng | Sya | Pursat River | 12°37.302' | 104°00.394' |
| Groundwater - GW1 | Kandieng | Kandieng | MRD/ADB well code no.07ADB 1502 036 | 12°35.200' | 103°57.975' |
| Surface water - SW2 | Phnom Kravanh | Leach Kravanh | Pursat River at PK Mt. Bridge | 12°21.288' | 103°45.373' |
| Groundwater - GW2 | Phnom Kravanh | Leach Kravanh | Commune well installed 2001 | 12°21.910' | 103°47.106' |

Source: Ministry of Environment and PGS Asia pacific Ltd, IEIA. 2008.

Table 4: Ground water (GW) Quality in Pursat Province

| Parameter | Units | GW-1 | GW-2 | Standard |
|--------------|-------|--------|--------|----------|
| pH | - | 6.48 | 7.26 | 6.5-9.2 |
| TDS | mg/l | 280 | 1118 | 1200 |
| Oil & Grease | mg/l | 0 | 0 | - |
| Hardness | mg/l | 309 | 372 | 500 |
| Iron | mg/l | 23.3 | 1.65 | 1.0 |
| Nickel | mg/l | 0.007 | 0.023 | - |
| Copper | mg/l | 0.020 | 0.050 | 1.5 |
| Zinc | mg/l | 0.024 | 0.383 | 15 |
| Arsenic | mg/l | 0.001 | 0.005 | 0.05 |
| Cadmium | mg/l | <0.001 | <0.001 | 0.01 |
| Lead | mg/l | 0.110 | 0.006 | 0.05 |
| Mercury | mg/l | <0.001 | <0.001 | 0.001 |

Source: Ministry of Environment and PGS Asia pacific Ltd, IEIA report. 2008.

8. **Land Use and Soil conditions.** The area surrounding the Damnak Scheme is almost covered by wet rice crop field in the plate upland areas. In and surrounding the Damnak Scheme, there are a few of forest resources such as: shrub-land, bamboo forest, grass land, and degraded forest-land in the upper watershed. The flooded forest land is covered in floodplain of Tonle Sap Lake and Mekong River Basin is far from Damnak Scheme. The scheme is not within Phnom Aural Wildlife Sanctuary and Protected Forest. There is no

protected area or archeological significant sites around the Damnak Scheme. According to the FAO classification system, the project area is classified as marginally suitable for rice and upland crops production (Appendix 1).

Figure 2: Forest Resources in the Canal Line and Wet Rice Field in the Project area



9. **Human and economic development.** The proposed scheme is located across three communes and two districts—Phteah Rung and Samraong communes in the Phnom Kravanh district and Ta lou commune in the Bakan district. There are 15 villages within the proposed scheme area and the populations in these villages are presenting in the table below:

Table 5: Population in Domnak Chhoeunkrom irrigated canal system area

| District | Commune | Village | Family | Female | Men | T. Population |
|---------------|-------------|---------------|--------|--------|-----|---------------|
| Phnum Kravanh | Phteah Rung | Phteah Rung | 170 | 803 | 648 | 1,451 |
| | Phteah Rung | Prohoas Kbal | 129 | 305 | 340 | 645 |
| | Phteah Rung | Chong Ruk | 326 | 792 | 730 | 1,522 |
| | Phteah Rung | Chrey Krem | 181 | 454 | 452 | 906 |
| | Samraong | Preaek Muoy | 367 | 938 | 845 | 1,783 |
| | Samraong | Preaek Bei | 208 | 543 | 535 | 1,078 |
| | Samraong | Ou Heng | 177 | 436 | 349 | 785 |
| | Samraong | Samraong Muoy | 115 | 409 | 354 | 763 |
| | Samraong | Samraong Pir | 346 | 1,005 | 874 | 1,879 |
| Bakan | Ta Lou | Thmei | 223 | 554 | 488 | 1,042 |
| | Ta Lou | Boas Kor | 172 | 510 | 602 | 1,112 |
| | Ta Lou | Brohal | 302 | 906 | 879 | 1,785 |
| | Ta Lou | Rohaltel | 294 | 640 | 710 | 1,350 |
| | Ta Lou | Prey kantout | 202 | 514 | 519 | 1,033 |
| | Ta Lou | Taing kok | 119 | 298 | 314 | 612 |

Source: Commune data. 2009.

10. Cambodia still experiences high poverty incident among countries in South East Asia though the poverty rate has declined from 35% as of 2004 to 30% as of 2007 (Cambodia Statistical Year Book 2008). Pursat is identified as one of the provinces in the Tonle Sap Basin with average poverty rate (42%) higher than the national average due to poor infrastructure, inadequate water supply and sanitation, lack of irrigation system, land mines, and lack of farming skills.

11. The main economic activity is agriculture. Most of the people who are living in Damnak Chhoeukrom project grow wet season rice (July/August to November/December) since rainwater is the main source of water supply for rice farming. The wet rice crop in this area is divided by three groups according to the time of maturity:

- (i) short time rice is taking 3 months with the planting area covering about 60% of total rice field

- (ii) medium time is taking 4 months, accounted for about 20% of the total rice field
- (iii) long time rice is taking 5 or 6 months, accounted for about 20% of the total rice field.

12. The wet season rice start planting from May and is harvested until November, depending on rice seed types, while dry season rice is planted from November in the field of small size located near the canals. It is expected that more farm land will be expanded for cultivation of dry season rice when the rehabilitation of the scheme is completed. Interview with local villagers and local officers involved in Damnak Ampil have confirmed a double or triple increase in areas of dry season rice.

13. Other jobs include growing fruits and home gardening of cash crops (vegetables) with small size to supplement consumption needs. Fishing is another secondary job at free time during flooding season and a few families set up local business.

14. **Potential Climate Change Impact.** Cambodia is considered highly vulnerable to climate change impacts with climate vulnerability index (CVI) varying according to the geographical location (Second National Communication, draft). Countrywide floods have accounted for 70% of rice production losses between 1998 and 2002, while drought accounted for 20% losses (Ministry of Environment, 2002). Pursat is identified moderately vulnerable to severe flooding and drought. However subsequent severe flooding was recorded in 1999 and 2000 followed by severe drought in 2001 causing damage to agricultural productivity in the province (Draft Second National Communication, 2010). Discussion with specialists from Provincial Department of Water Resources and Meteorology indicates that drought periods are observed frequently in Pursat during rainy season beginning in July or August and lasting about a month, which can cause low yields and production losses in the absence of irrigation schemes. Severe flooding and drought is projected to occur in terms of frequency and intensity (Ministry of Environment, 2009), which would have negative effects on irrigation structure and community coping capacity.

IV. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

15. The following section summarizes potential environmental impacts, mitigation measures and environmental monitoring requirements while a generic Environmental Management Plan (EMP) was developed (Appendix 2). The EMP will be updated based on the detailed design.

A. Environmental Problems Due to Project Location and Design

16. **Unexploded Ordnance (UXO).** Project works will take place in areas that are mostly trafficked. Thus, it is not likely to have a significant UXO risk. However, to avoid any risks, on all sites where excavation or ground clearance needs to take place, where there is a reasonable doubt as to the safety of the area an approved mine clearance agency will be engaged for an agreed package of verification, detection and clearance work, to ensure that all areas where excavation, or access construction will take place are clear of UXO. A cost of UXO clearance is included in the overall project cost.

17. **Protected areas.** The existing project is located outside all of the protected areas. The surrounding land use is dominated by paddy field. Thus, the potential impact on local ecological features is not envisaged.

18. **Downstream Impacts.** Pursat river consists of three main tributaries. Close coordination with Japan International Cooperation Agency (JICA) was made to determine any potential

negative impacts on the water availability at Damnak Ampil and related systems downstream in Pursat River. The water balance analysis confirmed that the proposed scheme is not likely to negatively affect the water availability of the Damnak Ampil system that is supported by JICA since the diversion of water from the tributary that joins the Pursat River is relatively small. With the 50-year design flow, the proposed diversion is 40 m³/s out of 870 m³/sec under the current climate condition and 1,130 m³/sec under the anticipated climate change. JICA is assisting the Provincial Department of Water Resources and Meteorology (PDWRAM) to promote Pursat River Basin management. Close cooperation between ADB and JICA is already in place in Cambodia to promote coordination between the Project and the JICA financed West Tonle Sap Irrigation and Drainage Rehabilitation and Improvement Project in Pursat in order to avoid any downstream impacts associated with the Project during the implementation and to build capacity of the PDWRAM and Farmer Water Users Groups (FWUGs)/Farmer Water Users Committees (FWUCs) better coordinate and share water resources.

B. Environmental Impacts during Construction

19. Some short-term adverse environmental impacts could occur during the construction phase in case of improper construction management. These impacts would include the mobilization of heavy equipment, location of worker's camps, and waste disposal. None of these impacts are expected to be significant. Specific environmental and social clauses (Appendix 3) will be included in the bidding documents to avoid potential adverse impacts.

20. Some heavy equipment (heavy trucks, bulldozers, backhoes, etc.) will be brought to the construction areas for excavation and construction works. They will only be transported in and out during the construction period. Since the project area is not heavily populated, no serious disturbance is envisaged. Some workers will be recruited for construction activities and workers' camp will be constructed. These will include non-skilled workers, operators and drivers as well as surveyors and construction supervisors. Awareness raising on occupational safety and health as well as proper management of machines, fuel, chemicals will be provided, monitored and reported.

21. Construction specifications will require contractors to follow the environmental management plan that specifies their obligation to (i) limit the generation of dust by watering exposed earth surfaces; (ii) provide covers on spoil heaps to prevent wind-blown soil loss; (iii) reinstate vegetative cover on all bare surfaces upon completion of the works, (iv) obtain permits for construction materials and appropriately dispose excavated spoil and other materials (vi) limit working hours in populated areas, and (vii) enforce the use of ear protection and dust filtering masks for workers.

C. Environmental Impacts during Operation

22. **Water pollution.** Currently, use of agricultural chemicals is low in the project area. However, the additional irrigation area of 16,000 ha may induce increased use of chemical fertilizers and pesticides. Environmental monitoring of a water quality is conducted by PDWRAM to assess any negative impact on the water bodies and collaborate with the provincial department of agriculture (PDA) to ensure appropriate use of agricultural chemicals.

23. **Sedimentation.** It is likely that sediment will build up in part of the main and secondary canals (intake, head works and cross regulators) and in the upper part of barrage built across Pursat River, which reduces flooding absorption capacity of the scheme and causes river morphology. Such problem has been encountered now by several irrigation schemes built along

Pursat River where dredging work is carried out to remove silt and sand from the river beds by the private contractors. Therefore appropriate monitoring and maintenance plan is envisaged and responsibility is coordinated among PDWRAM and FWUCs to ensure sustainable functions of the scheme.

24. Operation and Maintenance (O&M) and Water Management Coordination.

Inadequate operation of intakes and cross regulators together with poor water use management would result in poor distribution of irrigated water to the intended farming areas, water logging, flooding, water quality degradation and conflicts among farmers. The PDWRAM is responsible for the O&M of the main canals while FWUCs are responsible for the O&M of the secondary and tertiary canals. The PDWRAM has been providing a technical support to set up FWUCs. Establishment of new FWUGs/FWUCs and/or capacity building of the existing FWUGs/FWUC¹ is part of the project design and support to strengthen the water management capacity of FWUCs and FWUGs.

25. The Project has structural and non-structural measures to strengthen water resource management and coordination. Integration of traditional field reservoirs and drip irrigation systems in the Damnak ChhoeKrom Irrigation scheme will promote water management based on the needs of the local communities. Provision of capacity building for PDWRAM, FWUGs and FWUC and for System Rice Intensification training will promote efficient use of water, conflict resolution mechanism and farming techniques with reduced use of pesticide and chemical fertilizer. With these measures and close coordination with JICA, capacity of the PDWRAM, FWUGs and FWUC should be strengthened to better coordinate managed water resources in the Pursat River Basin.

D. Environmental and Social Benefits

26. The improved system will better control the water availability during the wet season for both irrigation and surrounding environment in the Project area. Irrigated farming areas, interconnected canals, natural ponds and man-made reservoirs are classified as wetland habitats that are suitable (if chemical and fertilizer use is under norm) for many aquatic life to prosper such as fish, frogs, crabs, snakes and water birds. Interview with FWUC for Damnak Ampil Scheme suggests a potential increase in fish catch due to increased volume of water in the Boeng Preah Punley reservoir after rehabilitation, which will in turn bring the fish price down. Water diverted from Pursat River for irrigation would provide opportunity for small-scale aquaculture development (integrated rice fisheries), increased vegetation cover and restoration of natural ponds and reservoirs that would serve as recreation areas for local communities and tourism attraction. The improved system would increase water table in the Project area thus providing more ground water available for small home gardening for wet and dry season crops and vegetables. Increased vegetation cover and seasonal water availability would result in moderation of micro-climate conditions beneficial to human and environment in the surrounding Project area.

¹ An FWUC consists of a number of Farmers Water User Groups (FWUGs). Normally the farm land under the scheme is divided into a number of small blocs with an area of about 40 ha or so, each of which is administered by an FWUG. An FWUC is the governing board, normally comprising chairman, several deputy chairmen, secretary and treasurer and in charge of overall coordination and overseeing effective implementation of water sharing plan by FWUGs, administration and finance, and intervention in conflicts over water use. An FWUG is charged with undertaking or ensuring the key activities – water sharing arrangement, collection of fees, and maintaining irrigation canals.

V. INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLAN

A. Project Implementation Arrangements and Institutional Responsibilities

27. The Ministry of Water Resources and Meteorology (MOWRAM) will be the Executing Agency (EA) responsible for overall management and coordination of the Project. The Implementing Agencies (IAs) will be the Department of Hydrology and River Works (DHRW) and the Provincial Department of Water Resources and Meteorology (PDWRAM) in Pursat. The Department of Meteorology (DOM) and the DHRW will be responsible for the non-structural component related to improvement in hydro-meteorological services and establishment of a national flood and drought forecasting and early warning center. The PDWRAM in Pursat will implementing the Damnak Chakroen irrigation rehabilitation and flood control project.

28. MOWRAM will establish a Central Project Management Unit (CPMU) at the national level, headed by a project director and a project manager who will be responsible for management and supervision of the activities of their respective IAs. The CPMU will include technical and accounting staff who have had experience with ADB procedures, rules, and guidelines; and who will be responsible for consultant recruitment, procurement, funds withdrawal, disbursement, and reimbursement. PDWRAMs will establish Provincial Project Management Units (PPMU) in the respective provinces to implement and coordinate the sub-project activities at the provincial and district levels.

29. The staff from the Ministry of Environment has been seconded to the work at the Department of Engineering of MOWRAM. This secondment arrangement will be continued under the proposed Project to assist the staff from MOWRAM and PDWRAM to update the IEE based on the detailed design and monitor the contractors' performance in environmental management. FWUCs will be established or strengthened to operate and manage the rehabilitated tertiary canals.

Table 6: Main Environmental Responsibilities

| Institution | | | Responsibilities |
|---|----------|-----------|--|
| Program | Steering | Committee | Responsible for providing overall guidance |
| (PSC) | | | |
| Ministry of Water Resources and Meteorology (MOWRAM) (Executing Agency)/ Central Project Management Unit (CPMU) | | | Responsible for reviewing and endorsing detail design including updated IEE/EMP to be submitted by PDWRAM. Ensuring inclusion of environmental clause in bidding documents. Providing technical support to PDWRAM in EMP implementation. |
| Provincial Project Management Units (PPMU) | | | Responsible for updating IEE based on a detail design. Responsible for monitoring and supervision of contractors and EMP implementation |
| Farmer Water Users Committee (FWUC) | | | Responsible for ensuring operation and maintenance (O&M) |

EMP = Environmental Management Plan; IEE = Initial Environmental Examination; PDWRAM = Provincial Department of Water Resources and Meteorology.

B. Environmental Monitoring Plan

30. River flow monitoring will be conducted to assess during the wet and dry season to ensure the adequate flow to realize the expected benefits. Environmental monitoring during construction is a responsibility of a contractor. A contract specification will include environmental monitoring to minimize construction impacts and implementation of mitigation measures indicated in the attached environmental impacts, mitigation and monitoring. Since the

construction is likely to complete within a year, environmental monitoring during the operation period is conducted by PDWRAM with a support from the other relevant local agencies to avoid any negative impacts presented below. The project will provide the cost of monitoring.

Table 7: Environmental Monitoring during Detail Design and Operation

| Potential Impacts | Environmental Performance Indicators | Frequency | Responsibility for Monitoring | Budget |
|--|--------------------------------------|---|-------------------------------|---|
| Detail Design | | | | |
| Availability of water and downstream impacts | River flow | Desk analysis based on the additional information on the upstream dams | PDWRAM | Included in the design cost |
| Operation | | | | |
| Water shortage downstream | Downstream water use survey | Once a year in dry season during project implementation | PDWRAM PDA | \$300/year (to be adjusted per scheme) |
| Water quality | Water quality Survey | Twice a year in wet and dry seasons with 5 parameters for rivers and 7 parameters for reservoirs stipulated in the water quality standard in public water areas, sub-decree on EIA. | PDWRAM | \$600/year (to be adjusted per scheme) |

EIA = environment impact assessment; PDA = Provincial Department of Agriculture, PDWRAM = Provincial Department of Water Resources and Meteorology.

VI. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

31. The consultation was an integral part of the project preparation and was carried out across all levels. On-site discussions with district and commune officials and participatory meetings with officials from relevant provincial line departments were conducted to disclose information and collect feedbacks on project design, social and environmental issues, and IEE. Two public consultations were organized to share the preliminary findings of the draft IEE. Additional informal discussion was carried out with farmers, especially women to get their concerns, needs, difficulties and suggestion. The participants generally support the Project. The main concerns raised at the meeting were related to involuntary resettlement as the proposed rehabilitation of the main and secondary canals will affect over 200 households. Such concerns were taken into considerations in the development of a resettlement plan. The final IEE based on the detail design with official endorsement will be translated and disseminated to the commune and district offices to keep it for public disclosure.

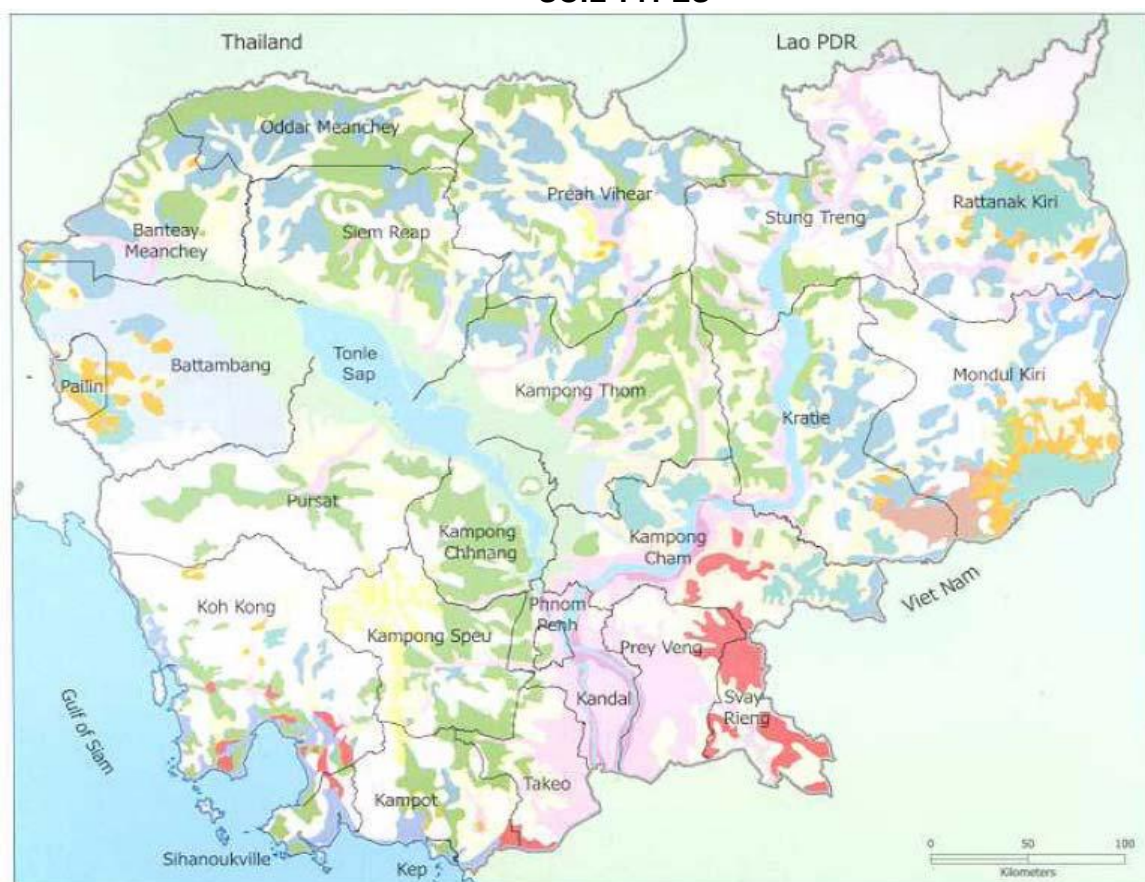
Table 8: Summary of Public Consultation's meetings

| Date | Time | Province | Districts/ Town | Communes | Meeting location | Number of participants |
|-----------------|--------------------|----------|--------------------|--------------------------|---------------------------|------------------------|
| 29 October 2010 | 2:30 pm to 5:00 pm | Pursat | Phnom Kravanh | Samraong and Phteah Rung | Beung Preah Ponlea Pagoda | 57 |
| 30 October 2010 | 1:30 pm to 4:30 pm | Pursat | Bakan | Ta Lou | Damnak Trop Pagoda | 86 |

VII. FINDINGS AND CONCLUSIONS

32. The Project will contribute to the improved preparedness to manage and reduce the impacts of flood and drought events and improve the overall livelihood through improved agricultural production due to improved performance of Damnak ChhoeKrom Irrigation scheme. The results of the draft IEE found that there will be no significant adverse environmental impacts associated the proposed works since the proposed Project will rehabilitate existing irrigation scheme. Potential negative environmental impacts are mainly short-term and can be mitigated. The proposed mitigation measures described in the Environmental Management Plan of the draft IEE should be sufficient to minimize any adverse impacts during the construction stage. The draft IEE will be updated once the detail design is developed. Specific environmental provisions will be included in the bidding documents to ensure implementation and monitoring of mitigation and monitoring measures in the contracts. Therefore, there is no need to carry out a full scale Environmental Impact Assessment (EIA).

SOIL TYPES



Legend

Soil Type

| | |
|---------------------------|--------------------------|
| Acid Lithosols | Planosols |
| Alluvial Lithosols | Plinthite Podzols |
| Alumisols | Plinthitic Hydromorphics |
| Basic Lithosols | Red-yellow Podzols |
| Brown Alluvial Soils | Regurs |
| Brown Hydromorphics | Soil Fertility |
| Coastal Complex | High Fertility Soil |
| Cultural Hydromorphics | Medium Fertility Soil |
| Grey Hydromorphics | Low Fertility Soil |
| Lacustrine Alluvial Soils | Water Body |
| Latosols | Provincial Boundary |
| | International Boundary |

Note: Refer to appendix for soil descriptions

Data Sources:

Soils: CARDI-after crocker, 1962

Soil Fertility: Gene-Ecological Zonation of Cambodia

International and Provincial Boundary: Department of Geography 2005

Water Body: JICA Dataset 2002

Soil Fertility



ENVIRONMENTAL MANAGEMENT PLAN

| Potential Environmental Impact | Nature and duration | Mitigation measure(s) | Monitoring | Cost | Responsibility |
|---|--|---|---|-------------------|------------------------------------|
| Impacts due to Location and Design | | | | | |
| Disturbance of Unexploded Ordnance | The project is the existing structure but | Unexploded ordnance (UXO) survey | | Project cost | Feasibility teams/designers PDWRAM |
| Encroachment of precious ecological areas. | There is no protected area within any reasonable distance. | N/A | N/A | N/A | N/A |
| Historical/cultural monuments and values | No historical or cultural monuments are located in the project area | N/A | N/A | N/A | N/A |
| Resettlement / Land Acquisition | Significant resettlement impact anticipated. | Resettlement Plan to be finalized | Independent monitoring agent | Government | PDWRAM |
| Downstream impacts | Water balance analysis confirmed no significant downstream impact due to diversion during wet season but competition for water use during dry season may arise | Water sharing arrangement and schedule planning between upstream FWUCs and downstream water users. | | | PDWRAM and FWUCs |
| Impacts due to Construction | | | | | |
| Soil erosion | Land clearing or excavation can cause excess sedimentation in nearby water bodies. | Obtaining materials from approved sources or suppliers. Silt controls during rainy season. | Weakly during construction | Construction Cost | Contractor |
| Noise and dust nuisance from construction activities. | Noise and dust is likely to be caused by excavation of canals and rehabilitation of headwork, and will be temporary. | Providing information to nearby residents by signage and notices in the local media about the duration of noise generating operations. Limit construction operations to take place during daytime hours only. Wetting of bare earth sites during construction in situations | Approved contract specifications and monitoring plan; | Construction Cost | Contractor PDWRAM |

| Potential Environmental Impact | Nature and duration | Mitigation measure(s) | Monitoring | Cost | Responsibility |
|--|--|--|--|--------------------------|-------------------------|
| Pollution from chemicals, fuels and temporary worker toilet facilities | The impact is temporary, as the risk will be confined to the construction period. | Secure and controlled storage of all toxic and hazardous materials including fuels. Provide sanitation arrangements at work sites, to avoid no raw sewage released into drains or streams. Maintenance of vehicles and plant in sound operable condition, preventing oil leakages and excessive exhaust emissions. | Approved contract specifications and monitoring plan | Construction Cost | Contractor PDRAM |
| Safety hazards to workers and the public | Workers or members of the public may be exposed to the risk of accidents during construction. The risk is temporary, and confined to the construction period. Threats to safety include injury from machinery or from falling, or from the use of hazardous chemicals. | Provision of protective clothing and equipment to workers as appropriate. Provision of hazard warning signs at construction sites as appropriate. | Approved contract specifications and monitoring plan | Construction Cost | Contractor PDWRAM |
| Impacts due to Operation | | | | | |
| Inadequate operation and maintenance (O&M) | Inappropriate operation of water control gates could cause a decrease in the available water for downstream or conflicting use of water rights | Project will provide resources to strengthen or set up FWUC by delivery of appropriate training drawing lessons learned in other schemes, training need assessment and its monitoring and evaluation | | PDWRAM Operation cost | PDWRAM FWUC |
| Water pollution | Increased use of fertilizer or agricultural chemical due to increased availability of water is likely on the increase. | Work with PDA or specialized nongovernment organizations (NGOs) such as HARVEST to provide agricultural extension for FWUGs and adjacent communities | | PDWRAM operation cost | PDWRAM FWUC FWUGs |
| Water resources Management | Joint coordination mechanism for river basin management will be initiated by JICA as part of its funded investment project. | Ensure adequate flow regime at different head-work. | | | PDWRAM FWUC |

| Potential Environmental Impact | Nature and duration | Mitigation measure(s) | Monitoring | Cost | Responsibility |
|--------------------------------|--|---|---|------------------------|------------------|
| Sediment accumulation | Water borne sediment from upstream will accumulate in the beds of Pursat river, main, secondary and tertiary canals evidenced by rapid sediment accumulation in Damnak Ampil and Charek Schemes. | Strengthen monitoring and maintenance capacity of PDWRAM and FWUCs with involvement of private sector drawing problem solving lessons in other schemes. | Dry season measurement of the volume, depth and area of accumulation. | PDWRAM and FWUC budget | PDWRAM and FWUCs |

FWUC = Farmer Water Users Community; FWUG = Farmer Water Users Groups; JICA = Japan International Cooperation Agency; PDA = Provincial Department of Agriculture, PDWRAM = Provincial Department of Water Resources and Meteorology.

PDWRAM = Provincial Department of Water Resources and Meteorology.

ENVIRONMENTAL AND SOCIAL CLAUSES FOR INCLUSION IN CONSTRUCTION CONTRACT TENDER DOCUMENTS

A. Use of Land for Construction Purposes

1. The contractor will obtain prior approval from landowners for temporary use of land for labor camp and construction yard, and before occupation agree on price, intended use and duration, amount of clearing and excavation, and final waste disposal and reclamation.
2. The contractor will not encroach upon or damage forests, wildlife or fisheries in the project area, and will provide a plan for preventing fires and possession of instruments or poisonous substances for killing or capturing fish or wildlife.
3. Temporary use of land will be promptly restored or improved in its pre-project conditions at no cost to the affected peoples. For the contractor working space, to the extent possible, only unused land will be used to avoid disruption to households and business establishments. Use of residential land will not involve any impacts on houses and structures and will not disrupt access to households.
4. Machinery, equipment, structures, contaminated earth and waste or unused materials shall be removed and disposed of properly. Fuel, oil, or parts cleaning fluids shall be spilled, wasted or disposed of at the appropriate site in accordance with the local environmental regulations.

B. Site Conditions, Quarries and Haul Routes

5. The contractor will provide a plan for development of haul roads that minimize interference with ongoing activity in the area. Haul routes shall be approved by the Local Administration Unit (LAU). Haul roads for unclassified fill in the project area shall be kept as close as possible to areas to be excavated.
6. The contractor will prepare and include in the bidding documents relevant management plans including a safety plan for accident prevention and response, environmental management at work camps, and overall waste management. Specific quantities of facilities such as drinking water supplies, toilet facilities, waste disposal bins, etc. should be estimated as much as possible.
7. Selection of quarry sites and haul routes shall minimize noise and air pollution in the quarry vicinity; visual impacts in inhabited areas; impacts on land use, air, soil erosion and noise emissions along haul routes; and congestion in populated areas. Quarry locations and haul routes will be approved in advance by the Site Engineer and LAUs.
8. Dust, noise and odors produced from nearby construction will be suppressed with various measures including watering haul roads regularly and operation of vehicles during restricted hours in village limits and other congested, or residential, areas.
9. The Contractor is required to post flagmen at intersections of transit paths for construction vehicles and local traffic.

10. Forms of interference that would disadvantage women and children in daily activity need to be avoided and specific safeguards put into place.

C. Archeological and Cultural Relics

11. The Contractor must halt construction upon discovery of foreign objects of non-recent origin on the ground or below grade. Contractor must notify the Site Engineer and LAUs, who will contact the Provincial Department of Culture and Fine Arts to investigate and undertake recovery. Work must remain halted at the specific location until recovery is complete.

D. De-watering and Disposal

12. Areas excavated for fill may need to be de-watered. The contractor is responsible for arriving at a plan to reduce sediment load in local drainage courses due to the discharge of water from excavations. The Site Engineer must approve the plan prior to start of excavation. Final discharges to local streams should contain TSS no greater than 300 mg/L.

E. Mines and Unexploded Ordnance (UXO)

13. The Contractor shall work closely with the LAU and local authorities and de-mining agencies to identify areas potentially contaminated with mines and UXO in and around the project. Areas within the active zone of construction shall be cleared of mines prior to start of work. The contractor shall educate workers on the hazards of mines and UXO, and post clear warnings at the boundaries of fields or forests in the vicinity of the project that are potentially contaminated with mines or UXO.