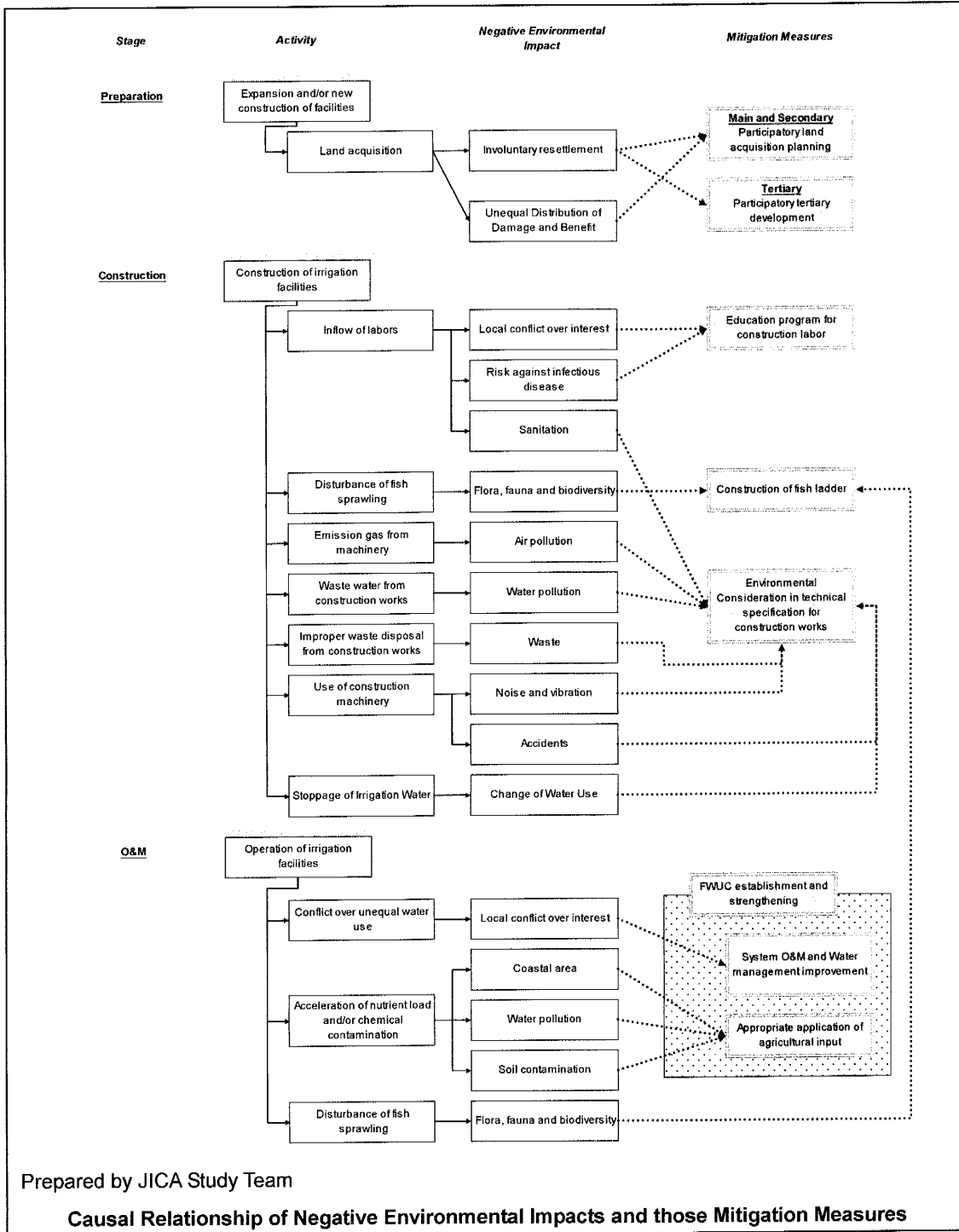


# CHAPTER 7 ENVIRONMENTAL MANAGEMENT PLAN

## 7.1 Environmental Impact Mitigation Measures

Environmental impact from the sub-project is identified from the view point of: (i) social environment, (ii) natural environment and (iii) pollution in the previous chapter. Causal relations of negative environmental impact and possible mitigation measures are shown as follows:



On the basis of the result of IEIA, this chapter outlines proposed mitigation measures required to mitigate or eliminate adverse impacts where identified likely arise in (i) preparation stage, (ii) construction stage and O&M stage. Certain other measures that could enhance environmental quality are also discussed.

(1) Preparation Stage

**(i) Involuntary Resettlement and/or Land Acquisition**

Land acquisition is an important and a sensitive matter for irrigation project and the Lum Hach sub-project is not left out. In general, the sub-project aims at the rehabilitation of existing irrigation and drainage facilities, therefore, there will be no significant resettlement and/or land compensation necessary for its implementation. In addition, the sub-project dose not expect to have specific impacts on ethnic minority under the irrigation command area, therefore, it does not require preparation of the plan for consideration of an ethnic minority.

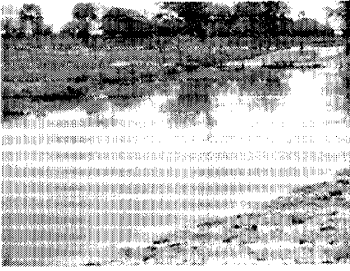


Upstream of Proposed Lum Hach Headworks (January 29<sup>th</sup>, 2008)

Land acquisition necessary under the sub-project is, in particular, for the construction of: (i) main and secondary facilities and (ii) tertiary facilities, which needs to consider different approach.

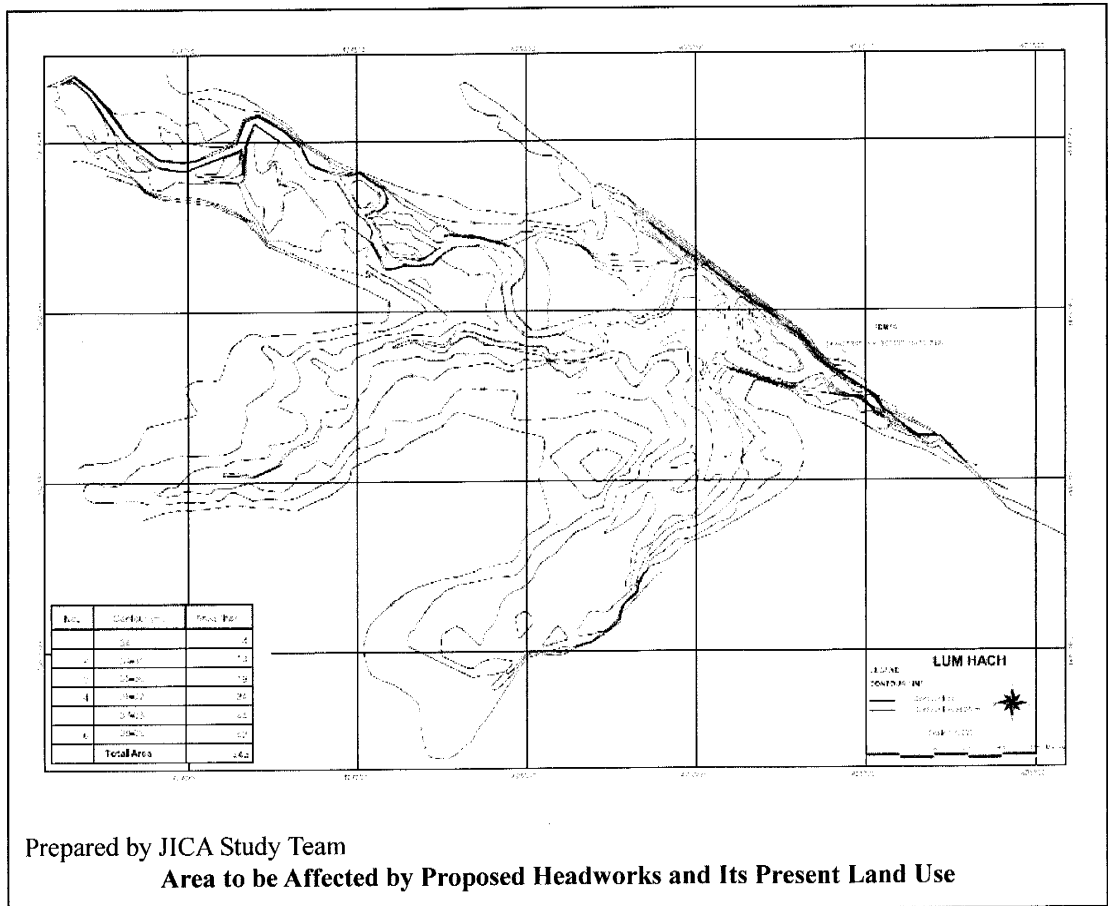
***Main and secondary level facilities – Participatory Land Acquisition Planning***

Activity
Expansion and/or new construction of facilities (Main, secondary and sub-secondary canals) and those related facilities
Affected area and people
30.0 ha, approximately 284 households along the alignment of main and secondary level facilities
Negative environmental impact anticipated
<u>Involuntary resettlement and/or land acquisition</u> Land acquisition will be necessary for: (i) the upstream of proposed headworks, area of which will be submerged and (ii) the expansion and/or new construction of irrigation and drainage facilities as well as inspection roads along main and secondary canals, which will be of varying length and width among the level of canals and drains based on the size of command areas. Preliminary estimate of the necessary areas for the acquisition is as follows: Upstream of the headworks <u>143 ha (approximately 12 households)</u> as additionally explained afterward, Main canal: 10.8 ha (approximately 164 households) Secondary canal: 79.5 ha (approximately 994 households), including sub-secondary canal Main drain: - Secondary drain: 29.5 ha (approximately 492 households)

Corrector drain: -
Total 262.8 ha (approximately 1,662 households)
Note: The area includes inspection roads along the canals.
<b>Mitigation measures</b>
<ul style="list-style-type: none"> <li>➤ The alignment of the proposed canals should follow the original canals as facilities so as to minimize land acquisition.</li> <li>➤ It is of necessity to facilitate coordination among Inter-ministerial Resettlement Committee (IRC) and local-based authorities to properly carry out: (i) asset valuation at replacement cost and resettlement cost estimation to be affected through the implementation and (ii) compensation measures.</li> <li>➤ Compensation rate for land loss and value of land based on field interview carried out in June 2008 is US\$ 0.3/m<sup>2</sup> for agricultural field. This replacement cost will be updated by MOWRAM prior to the implementation of the sub-project based on market price.</li> <li>➤ Step-wise consensus building needs to be conducted with affected people and communities through workshop for: (i) canals and drains alignment, (ii) compensation measures and (iii) support necessary for sustainable O&amp;M.</li> <li>➤ Although not necessarily physical compensation needed in accordance with the land-related laws and regulations, consensus building should be made with farmers currently doing cultivation in the main canal.</li> <li>➤ Training program would be effective for IRC members, particularly MOWRAM and PDOWRAM staff, curriculum of which primarily consist of: (i) participatory and community development skills, (ii) conflict resolution and mediation, (iii) risk assessment and management, and (iv) resettlement planning.</li> </ul>

<p><b>Main Canal to be Rehabilitated and Extended</b> (January 29<sup>th</sup>, 2008)</p>
<b>Stakeholders</b>
<ul style="list-style-type: none"> <li>➤ Inter-ministerial Coordination Committee (IRC)</li> <li>➤ MOWRAM</li> <li>➤ PDOWRAM</li> <li>➤ Commune Council</li> <li>➤ Village Development Committee</li> <li>➤ Representative of farmers</li> <li>➤ Affected Farmers</li> </ul>

Prepared by JICA Study Team

Area to be affected by proposed Lum Hach Headworks and its present land use is illustrated as follows:



Prepared by JICA Study Team  
**Area to be Affected by Proposed Headworks and Its Present Land Use**

On this basis, land classification, area and affected people are summarized in the right table. All the land is state-property and no private land is included. No land acquisition will be required for river course and river bank. On the other hand, land acquisition necessary is primarily paddy field, grazing land and residential area.

**Land Use Classification of the Upstream of Proposed Headworks**

Classification	Area (ha)	Affected People (household)
River Course	20.0	0
River Bank	30.0	0
Forest	30.0	0
Paddy Field	30.0	10
Grazing Land	32.5	0
Residential Area	0.5	12
<b>Total</b>	<b>143.0</b>	<b>12</b>

Note: Affected people from the category, paddy field overlaps with the category, residential area, therefore, total affected households are estimated to be 12 nos.

Prepared by JICA Study Team

In the submerged area, administratively there are two villages: (i) Chan Peak, (ii) O Rom Chek and (iii) Sokmoang. Number of affected households is estimated to be 12 households, all of which are temporary houses only in the wet season through illegal resettlement. Although they are the encroachers, proper resettlement process needs to be carried out in accordance with the draft sub-decree by MOWRAM through the consultation with IRC during the preparation phase of the sub-project.



Bund Observed as Demarcation , but No Tertiary Canals Developed at Present (January 29<sup>th</sup>, 2008)

Currently, no tertiary level facilities have been developed in the sub-project command area. In order to materialize effects of facilities rehabilitation and development at the main and secondary level, construction of tertiary canals and drains together with inspection roads needs to be concurrently promoted. Different from main and secondary level facilities, however, tertiary level development is the responsibility of local authorities and communities technically supported by MOWRAM and PDOWRAM. Therefore, local-based consensus building, planning and implementation is of great importance for the development of tertiary level facilities.

### ***Tertiary level facilities – Participatory Tertiary Development***

Activity
Construction of tertiary level facilities (Canals and drains)
Affected area and people
65.1 ha, approximately 930 households along the alignment of tertiary level facilities
Negative environmental impact anticipated
<u>Involuntary resettlement</u> The necessary land acquisition for the construction of tertiary facilities is estimated as follows: Tertiary canal: 43.4 ha (approximately 620 households) Tertiary drains: 21.7 ha (approximately 310 households) Total 65.1 ha (approximately 930 households) Note: The area includes inspection roads along the canals.
Mitigation measures
<ul style="list-style-type: none"> <li>➤ Appropriate procedure for tertiary development is essential including compensation measures for affected farmers.</li> <li>➤ The canals and drains will be proposed through joint-walk-through survey among engineers of PDOWRAM, affected farmers and local authorities such as commune council and village development committee. The alignment will follow existing bund wherever possible so as to minimize land acquisition.</li> <li>➤ Cooperation among local communities such as commune council and village development committee needs to be enhanced.</li> <li>➤ Training program would be required for the members of local authorities particularly commune council, village development committee and representative of farmers, curriculum of which consist of the subjects in mentioned in “the main and secondary facilities” plus: (i) facilitation skills, (ii) preliminary design of tertiary level facilities including canals, drains and appurtenant structures, and (iii) monitoring and evaluation of the activities at the local level.</li> </ul>
Stakeholders
<ul style="list-style-type: none"> <li>➤ MOWRAM</li> </ul>

- PDOWRAM
- Commune Council
- Village Development Committee
- Representative of farmers
- Member farmers of tertiary blocks (FWUG)

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(2) Construction Stage

In the construction stage, negative environmental impacts to be expected for sub-project implementation are: (i) local conflict over interest, (ii) risk against infectious disease, (iii) impact to flora, fauna and biodiversity, (iv) air pollution, (v) water pollution, (vi) waste disposal, (vii) noise and vibration and (viii) accidents, those of which are mutually and closely correlated.

**(i) Local Conflict Over Interest and Risk Against Infectious Disease**

***Education Program for Construction Labor***

Activity	Construction of Irrigation and Drainage facilities (Canals and drains)
Affected area and people	In and around sub-project area
Negative environmental impact anticipated	Because of the inflow of construction workers from outside of sub-project area, following negative impact is expected such as: (i) deterioration of security, (ii) deterioration of sanitary condition, (iii) increase of infectious disease etc.
Mitigation measures	<ul style="list-style-type: none"> <li>➤ Education program should be carried out for the workers in order to maintain security, sanitary condition and to follow community rules.</li> <li>➤ Public meeting should be organized for community people so as to explain about construction schedule.</li> <li>➤ Information on construction works is disseminated to the communities through poster and/or brochure to raise awareness.</li> <li>➤ Technical specification of the construction works, as explained afterward, “<i>Environmental Consideration in Technical Specification for Construction Works.</i>” needs to include obligation of contractors for the preparation of appropriate base camp and facility for construction workers.</li> </ul>
Stakeholders	<ul style="list-style-type: none"> <li>➤ Contractors</li> <li>➤ Construction Workers</li> </ul>



Public Meeting Organized with the Community Members (January 28<sup>th</sup>, 2008)

- Community People
- Local Authority
- MOWRAM
- PDOWRAM

Prepared by JICA Study Team

**(ii) Flora, Fauna and Biodiversity**

***Construction of Fish Ladder***

Activity
Construction of Lum Hach Headworks
Affected area and people
Fishers presently doing fishing in Boribo River
Negative environmental impact anticipated
<p>There are, currently, some fishers carrying out fishing in Boribo River especially in the wet season. The ecological resources of the stream serve as habitat for several black fish species. Under the sub-project, the headworks are proposed to be newly constructed as a part of main irrigation facilities. It would disturb fish sprawling in the River thereby decreasing fish yield of fishers. Without appropriate measures, in addition, such ecological resources in the river will be affected.</p>
Mitigation measures
<ul style="list-style-type: none"> <li>➤ In conformity with the rehabilitation of gate, the construction of fish ladder needs to be considered in order to maintain downstream flows and upstream migration to the sustainability of fish catches as well as ecological resources.</li> <li>➤ Features to be taken into account before implementation of the sub-project include the biological and physiological characteristics of migrating species as well as the course, speed, width and depth of the fish pass. Previous lessons for the effectiveness of fish ladder constructed in other projects needs to be reviewed and assessed such as the fish path constructed for the Stung Chinit Reservoir under the Stung Chinit Irrigation and Rural Infrastructure Project (ADB).</li> </ul>
Stakeholders
<ul style="list-style-type: none"> <li>➤ MOWRAM</li> <li>➤ PDOWRAM</li> <li>➤ Community People particularly Fishers</li> <li>➤ Local Authority</li> </ul>



Fishers in the Boribo River  
(January 29<sup>th</sup>, 2008)

Prepared by JICA Study Team

**(iii) Sanitation, Water Use, Air Pollution, Water Pollution, Waste, Noise and Vibration and Accidents**

***Environmental Consideration in Technical Specification for Construction Works***

Activity
Rehabilitation and/or Construction of Irrigation and Drainage facilities
Affected area and people
In and around sub-project area
Negative environmental impact anticipated
<p>All the negative impacts are directly related with the construction works, particularly the operation of construction machinery during construction works. Potential adverse impacts are as described respectively as follows:</p> <p><b>Sanitation:</b> Inflow of construction labor would increase possibilities on sanitary deterioration in and around sub-project area by disposing of domestic waste.</p> <p><b>Water Use:</b> Cropping during construction period will be affected if irrigation water supply is completely terminated. In addition, although current percentages are limited as refer to section 4.3.6, community members using river water for drinking and domestic use would be affected when river water flow change due to temporary works such as diversion and coffer dam for canal construction.</p> <p><b>Air pollution:</b> Emission gas will be exhausted by the transportation of construction machinery such as excavator, bulldozer, watering lorry and so forth.</p> <p><b>Water pollution:</b> In particular, water in the downstream of the sub-project will be affected by water pollution through improper dumping of construction waste. In addition, poor de-watering from, for example, borrow areas affect water quality in surrounding areas, for which appropriate measures needs to be taken.</p> <p><b>Waste disposal:</b> Solid waste will be created from waste from construction materials and machinery. There needs to be appropriate management measures put in place for waste to be generated.</p> <p><b>Noise and vibration:</b> Construction machinery will create noise and vibration during construction. In particular, site of intake and beginning of main canal is the nearest to the village which needs to be considered.</p> <p><b>Accident:</b> Through the operation of construction machinery, consideration to the mitigation of accidents in and around sub-project areas especially access between national road No. 5 and the sub-project site needs to be carefully carried out.</p>
Mitigation measures
<ul style="list-style-type: none"> <li>➤ In the technical specification of the construction works, obligation of the contractors for the consideration of: (i) water use for agriculture, drinking and domestic use, (ii) air pollution, (iii) water pollution and treatment, (iv) waste disposal, (v) noise and vibration and (vi) accidents needs to be clearly specified. Sample specification with the preliminary level is introduced afterward.</li> <li>➤ On the basis of specification, education programs for construction workers should be carried</li> </ul>



<p>out under the obligation of the contractors.</p> <p>➤ Periodical patrol and monitoring needs to be carried out by the staffs of PDOWRAM and local authorities to ensure environment-friendly ways in construction works.</p>
<p>Stakeholders</p> <p>➤ PDOWRAM</p> <p>➤ Local Authority</p> <p>➤ Contractors</p> <p>➤ Community People</p> <p>➤ MOWRAM</p>

Prepared by JICA Study Team

Technical specification for the construction works needs to consider matters in the table below to mitigate negative environmental impact in and around the sub-project site during construction period. The contents consist of: (i) general, (ii) earth work, (iii) care of water, (iv) sod facing, (v) site clearing, and (vi) operation of temporary labor camp.

**Subjects to be Considered for Environmental Impact Mitigation for the Construction Works**

No.	Clause	Sub-Clause
I-01	General	-
I-02	Earth Work	<ul style="list-style-type: none"> <li>✓ Safeguarding excavated and natural slope</li> <li>✓ Spoil disposal</li> </ul>
I-03	Care of Water	<ul style="list-style-type: none"> <li>✓ Design</li> <li>✓ Dewatering during construction</li> <li>✓ Drinking and irrigation water supply during construction</li> </ul>
I-04	Sod Facing	-
I-05	Site Clearing	<ul style="list-style-type: none"> <li>✓ Disposal of material</li> </ul>
I-06	Operation of Temporary Labor Camp	<ul style="list-style-type: none"> <li>✓ Operation, maintenance and removal of camp</li> </ul>

Prepared by JICA Study Team

<p><b>Box-1: Subjects to be considered for environmental impact mitigation for the construction works</b></p> <p style="text-align: center;"><b>ENVIRONMENTAL CONSIDERATION FOR THE CONSTRUCTION WORKS</b></p> <p><b>I-01 GENERAL</b></p> <p>Environmental consideration necessary for the civil works consisting of construction of intake weir, rehabilitation of canals and related structures are specified in this Chapter. The Contractor shall perform the works with environmentally sound as specified or as directed by the Consultant. The Contractor shall prepare and submit to the Consultant for his approval the construction program of this Chapter for respective structures under each work component prior to commencement of the works.</p> <p><b>I-02 EARTH WORK</b></p> <p><b>I-02-1 Safeguarding Excavated and Natural Slope</b></p> <p>The Contractor shall be responsible for the stability of the excavated slopes and of natural slopes affecting or affected by the Work. Stockpiles shall not be formed within such distances behind</p>
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excavated or natural slopes as should thereby reduce the stability of the slope. The Contractor shall be responsible for the stability of all slopes to spoil tips and of natural slopes affected by spoil tips or by borrowing.

The Contractor shall be responsible for carrying out all remedial works including any necessary backfilling and regarding as in the opinion of the Consultant may be necessary to stabilize any incipient or actual failure or to reinstate any actual failure in any excavation, spoil embankment and/or natural slope affected by any temporary or permanent work.

#### **I-02-2 Spoil Disposal**

Excavated materials from the works for re-use are to be placed directly in its final position, and may be stacked on site as approved by the Consultant. Spoil unfit for re-use shall be removed to the spoil areas, which may be borrow areas or other areas after extracting earth, approved by the Consultant. All spoil areas shall conform to the following requirements:

- (a) Drainage shall not be polluted or obstructed.
- (b) Debris shall not be left where it may be carried by water to the dam and intake, or into the canal.
- (c) On completion of the Work the spoil areas shall be graded to the profiles and contours as approved by the Consultant, shall be of tidy appearance, and shall be such as will not detract from the general amenity of the surrounding area.
- (d) Any topsoil covering the intended spoil area should be removed and stockpiled for use in the restoration work described in (c).

#### **I-03 CARE OF WATER**

##### **I-03-1 Scope of Work**

The work specified in this Clause is related with the construction of intake weir, ditches, and sumps and other protective works for the care of surface water during construction to ensure that the Work will be carried out in the dry condition, to mitigate dissemination of water-borne disease through the Project, and to minimize adverse impact on water use by communities in and around the site.

##### **I-03-2 Design**

All coffering as well as methods of execution of the Work shall be designed in detail by the Contractor and subject to the approval of the Consultant. The Contractor is fully responsible for a proper design, construction, maintenance, and removal of coffering.

The Contractor shall prepare the program of each cofferdam containing general design drawings, working procedure, time schedule and dewatering, and shall be submitted to the Consultant for his approval at least 7 days prior to commencement of any work under this Clause. These documents shall include but not limited to, the layout and the design calculation of cofferdams.

All works of permanent structures shall be performed in areas free from water, unless otherwise specified, or authorized by the Consultant.

The Contractor shall repair at his expense any damage to foundations, to any structure shown on the Drawings and to construction facilities for the Work including those in this Clause, which is caused by floods, surface runoff water, or failure of any part of the diversion or protective work in the Project.

##### **I-03-3 Dewatering during Construction**

The work shall include the design and construction of pits, trenches, facilities for dewatering equipment including furnishing, installation, operation, maintenance, depreciation, relocations, and removal required for the execution of all works (excavation, embankment, slope protection, concreting, pilling, etc.). The Contractor shall arrange sufficient number of sand pumps and/or so capable pumps for dewatering of the works, particularly intake weir, in considering of the geological constitution and surroundings. The Contractor shall arrange the pump as new as possible in order to avoid trouble

during operation which may cause the delay of construction.

As soon as the drainage facilities designed by the Contractor and approved by the Consultant are completed, they can be used by the Contractor who will be responsible for the maintenance of these facilities until the completion of the respective Works or section of Works.

**I-03-4 Drinking and Irrigation Water Supply during Construction**

All the works shall be performed in consideration of current water use of community members in the site. The Contractor shall prepare mitigation measures for minimization of any adverse impact on current water use by community members in the site incurred by the construction works, as directed by the Consultant.

**I-04 SOD FACING**

The Contractor shall perform sod facing on the slopes of embankment or excavation if it is shown on the Drawings or directed by the Consultant in order to protect the slopes from erosion.

The sod shall have healthy living stem and roots and obtained from heavy thickly matted soil in the approved locations having similar growing conditions. The sod to be used shall be free of weeds or undesirable plants. When the sods are cut, grass height shall not exceed 10 centimeters and they shall have soil adhering to the roots when planted. The sod shall be planted within 24 hours after cutting in continuous lines on the slopes of the embankment or excavation in close contact and then tamped firmly in place. Immediately after placing, the sodded slopes shall be watered and kept moist until plant growth has been re-established.

The sod facing area of the slope shall be covered more than 80 percent of the area of the slope.

The Contractor shall prepare program of sod facing work basing on his demonstrable background of sod planting and submit it to the Consultant for the approval.

The Contractor shall protect the sodded area during the time when vegetation is becoming established. If objectionable weeds or other undesirable growths smother the planted species such vegetation shall be removed from the area.

**I-05 SITE CLEARING**

**I-05-1 Scope of Work**

This Clause covers all works requiring disposal of waste materials created from the construction works.

**I-05-2 Disposal of Material**

The material removed in clearing and/or demolishing operations shall be burned, or otherwise disposed of, as approved by the Consultant.

All materials to be burned shall be piled neatly and when in a suitable condition shall be burned completely. Piling for burning shall be carried out in such a manner and in such a locations as to create the least fire risk.

All burning shall be so through that the cleared materials will be reduced to ashes. The Contractor shall at all the time take special precautions to prevent fire from spreading and shall have available at all the time suitable equipment and supplies, for use in preventing and fighting fires.

All the materials creating harmful gas, if burned, shall be disposed appropriately. The Contractor shall prepare plans on procedures of disposal and get approval from the Consultant prior to any operations.

**I-06 OPERATION OF TEMPORARY LABOR CAMP**

**I-06-1 Scope of Work**

The Clause covers temporary labor camp which the Contractor shall rent or construct as he may require for his own use and for his labor employed for the Works. The Contractor shall operate such

camps so as not to disturb any environmental conditions in the project areas.

**I-06-2 Operation, Maintenance and Removal of Camp**

Operation and maintenance of the Camp including all services and access roads shall be entirely the responsibility of the Contractor and at his expense. The Contractor shall provide all garbage and refuse collection and disposal at appropriate frequency as approved by the Consultant.

Upon completion of the Works, the Contractor shall remove all facilities and temporary structures built by him as part of his camp, fill in all excavated areas, remove all refuse, debris and objectionable material so that the camp areas will be left in clean and neat condition, to the approval of the Consultant.

(3) O&M Stage

Adverse environmental impacts anticipated during O&M stage are related with increased and improved irrigation water use after implementation of the sub-project. Mitigation would be FWUC establishment and strengthening, which are sub-categorized into two: (i) system O&M and water management improvement and (ii) appropriate application of agricultural input. They are relevant to overall O&M and agricultural support, therefore, activities proposed here should be carried out in comprehensive support programs.

**(i) Local Conflict over Interest**

***System O&M and Water Management Improvement***

Activity
Operation of Rehabilitated and/or Constructed Irrigation and Drainage facilities
Affected area and people
In and around sub-project area including downstream areas
Negative environmental impact anticipated
Unequal water allocation would be anticipated if proper water management is not carried out in the sub-project command areas. This issue is related not only within command area but also with other irrigation systems particularly located in the downstream of the Lum Hach sub-project.
Mitigation measures
<ul style="list-style-type: none"> <li>➤ Farmer Water User Community (FWUC) needs to be established and strengthened to carry out appropriate irrigation system O&amp;M and water management.</li> <li>➤ FWUC establishment should be through stepwise approach as stipulated in PIMD Module: (i) initial Meeting to identify constraints and opportunities within communities, (ii) identify irrigation area and potential members for FWUCs through Participatory Rural Appraisal (RRA), (iii) consensus building among FWUCs for activities plan, (iv) preparation of FWUC statute and by-laws, (v) establishment of FWUCs and selection of leaders, (vi) capacity building of FWUCs for preparation of irrigation service plan, (vii) finalization of irrigation service plan, (viii) preparation and adoption of management transfer agreement, (ix) rehabilitation of systems through FWUCs participation and (x) provision of periodical support services to continue FWUC capacity building based on lessons learned from above activities.</li> <li>➤ Training on system O&amp;M and water management needs to be carried out, contents of which</li> </ul>

are briefed as follows:

Category	Sub-category	Training Items
System O&M	Community Participatory O&M and Rehabilitation	<ul style="list-style-type: none"> <li>• Community participatory rehabilitation (Awareness program, planning, designing, contract management, financial management and construction management)</li> <li>• Maintenance planning</li> <li>• Establishment of O&amp;M fund</li> </ul>
Water Management	Proper Water Management at Tertiary level	<ul style="list-style-type: none"> <li>• Awareness on water management</li> <li>• Preparation of irrigation schedule</li> <li>• Gate operation, monitoring (discharge measurement, recording and reporting), rotational irrigation &amp; role gate operator</li> <li>• Drainage improvement</li> <li>• Participatory M&amp;E for water management</li> <li>• Conflict resolution with other systems</li> </ul>

**Stakeholders**

- MOWRAM
- PDOWRAM
- Community People including those of downstream irrigation systems
- Local Authority
- NGOs, if necessary

Prepared by JICA Study Team

***(ii) Coastal Area Pollution, Water Pollution, and Soil Contamination***

***Appropriate Application of Agricultural Input***

Activity
Implementation of irrigated agriculture using Rehabilitated and/or Constructed Irrigation and Drainage facilities
Affected area and people
In and around sub-project area including downstream areas
Negative environmental impact anticipated
Good quantity of the irrigation water (high oxygen levels, low nutrient and dissolved salts concentration) is not conducive to excessive growth of algae and water weeds, and will neither lead to soil salinization problems. Excessive use of these are known to harm the balance of nature, damage aquatic life, cause eutrophication and create problems to downstream water users as well. With the expected transfer of improved farming technology and the expansion of the arable land based on the rehabilitation of irrigation facilities, it would encourage farmers to use higher level of agro-chemicals and fertilizers so as to ensure higher agricultural productivity at a future point of time. Adverse impacts on water quality in the downstream of irrigation systems needs to be considered, particularly nutrient load and/or chemical contamination in the water.
Mitigation measures

- It is proposed to carry out a support program for appropriate farming particularly chemical and fertilizer application, and processing of compost by farmers.
- Pesticides in Cambodia are classified into three categories: (i) banned, (ii) restricted and (iii) permitted by the announcement of MAFF, the criteria of which is based on WHO.<sup>3</sup> An awareness among farmers in the short-term on the hazards of using toxic chemicals will be created. Community-based mutual checking systems should be established among FWUC members for proper chemical and fertilizer application on this guideline basis supported by extension agent.
- Integrated pest management (IPM) will be introduced in a step-wise manner on methodology with the active involvement of relevant organizations (PDA, PDOWRAM and local authorities).
- Periodical water quality monitoring should be carried out within the canals in the command area and downstream areas by PDOWRAM.



High Turbidity of the Water due to Fish Pond in the Main Canal (January 29<sup>th</sup>, 2008)

#### Stakeholders

- MOWRAM
- MAFF
- PDOWRAM
- PDA
- Community People including those of downstream irrigation systems
- Local Authority

Prepared by JICA Study Team

#### **(iii) Flora, Fauna and Biodiversity**

An impact on flora, fauna and biodiversity is to be caused due to disturbance of fish sprawling in the Boribo River. As having already explained in the previous section, construction of fish ladder needs to be considered during preparation and construction phase in appropriate plan, design and construction process. In addition, effectiveness of fish ladder and fish yield should be monitored and evaluated in the O&M stage by local agencies and communities.

## **7.2 Environmental Management and Monitoring Plan**

In the previous sections, seven measures are proposed in order to mitigate adverse environmental impact from social and natural view points:

#### **Preparation Stage**

- Participatory land acquisition planning for main and secondary facilities development,

<sup>3</sup> The announcement No. 598 (December 15<sup>th</sup> 2003) issued by MAFF stipulated that there are respectively: (i) 116 nos. of banned, (ii) 40 nos. of restricted and (iii) 136 nos. of permitted pesticides.

- Participatory tertiary development,

#### Construction Stage

- Education program for construction labors,
- Construction of fish ladder,
- Environmental consideration in technical specification for construction works,

#### O&M Stage

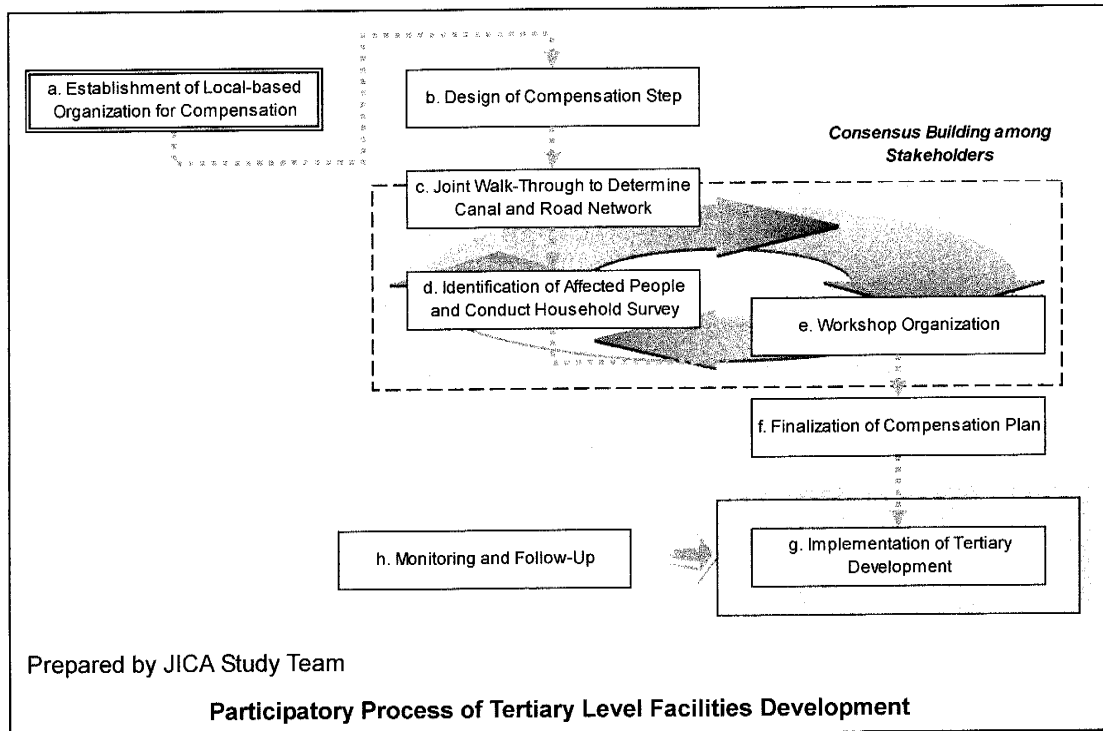
- System O&M and water management improvement, and
- Appropriate application of agricultural input.

As for the environmental monitoring, two plans are proposed: (i) participatory land compensation process for tertiary development and (ii) soil and water quality monitoring. Both of them are involved in the mitigation measures under the sub-project implementation. And they should be monitored in the long-term in order to materialize project effect through social and natural environment-friendly manner.

#### (1) Participatory Land compensation Process for Tertiary Development

Land compensation for the construction of main and secondary level will be the responsibility of the Government with IRC, the role of which is determination of entitlements, value of the lands and follow-up appropriate compensation process through information disclosure, detailed compensation planning and public consultation. The process of land acquisition for tertiary level development, however, has not been stipulated at the Central Government level. Instead, they are the responsibility on local government particularly commune councils.

Land acquisition would be sensitive issues. And there is no official process of land acquisition at tertiary level stipulated in any regulations, therefore, careful design of the process needs to be carried out so as to ensure sustainability of the project in sociologically suitable way. In this process, full public participation and meaningful consultation with the people and communities who may have potential adverse impacts from development activities is one of the important keys to success. Preliminary idea on land acquisition and compensation process at tertiary level is, therefore, illustrated as follows and explained afterward:



- a. **Establishment of local-based organization for compensation:** Locally-based compensation committee should be established in charge of tertiary level land acquisition consisting of PDOWRAM, PDA, Provincial Department of Land Management, Urban Planning and Construction (PDLMUPC), Commune Council, Village Development Committee, FWUC etc.
- b. **Design of compensation step:** Among committee members, compensation step is discussed and designed taking land tenure and local economic conditions into consideration. Rough idea on tertiary level canal, drain and road alignment is discussed as follows.
- c. **Joint walk-through to determine canal and road network:** Joint walk-through is carried out involving PDOWRAM engineer, representatives from village and farmers to determine optimum canal and road network, process of which needs both social and technical consideration. NGOs familiar to the Lum Hach Sub-Project can be also resource persons to facilitate this process.
- d. **Identification of affected people and conduct household survey:** This step is coherent with joint walk-through in the preceding step. Through joint walk-through survey using designed checklist, affected areas are identified, therefore, affected people are confirmed. Socio-economic survey, then, is conducted to collect information on socio-economic conditions, their opinions, impacts by land acquisition etc. Consensus among affected people should be built through this process.
- e. **Workshop organization:** Public consultation and information disclosure would be of critical importance in land acquisition as well as tertiary development planning. Therefore, draft plan is disclosed to get feed-back from stakeholders by organization of



the workshop. Affected asset valuation is also agreed through this process, if any, although physical compensation is not stipulated in the regulation for tertiary development.

- f. **Finalization of compensation plan:** Land acquisition, compensation as well as tertiary development plan are finalized on the basis of stakeholders' opinion in the workshop.
- g. **Implementation of tertiary development:** Based on the implementation plan agreed in the preceding steps, tertiary development is carried out including land acquisition and construction.
- h. **Monitoring and follow-up:** Compensation committee is responsible for the monitoring during the implementation of land acquisition. In particular, progress of tertiary development is periodically monitored by the committee.

(2) Water and Soil Quality Monitoring

In the Battambang Province, water quality monitoring has been carried out only at Bac Plea station of Battambang River since August 2004 by the Water Quality Analysis Office of the Hydrology and River Works Department under MOWRAM. No monitoring has not been conducted by PDOWRAM in and around the sub-projects including the water source, the Boribo River.

Training of farmers for appropriate application of chemicals and fertilizer are proposed to be supported under agricultural support program. In addition, a regular monitoring of soil and water quality needs to be concurrently carried out. The index of soil and water quality monitoring framework are tabulated as follows:

**Soil and Water Quality Monitoring for the Projects**

No.	Indicators	Method	Frequency	In-Charge
1.	pH	pH meter	Two times a year (dry and wet season respectively)	PDOWRAM/PDOE
2.	Electric Conductivity	EC meter		PDOWRAM/PDOE
3.	DO, Coliform, Nitrite, BOD, Total Nitrogen	Gas membrane electrodes		MOWRAM/PDOWRAM/ PDOE
4.	Total Phosphorous	Spectrophotometer		MOWRAM/PDOWRAM/ PDOE
5.	Metals, Nutrients, COD, Total Organic Carbon	Colorimeters		MOWRAM/PDOWRAM/ PDOE

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In this chapter, environmental impact mitigation measures and monitoring plan is described on the basis of negative impact identified. The timeframe of proposed environmental management-related activities is depicted as follows:

	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
<b>Sub-Project Implementation</b>						
Design	██████████					
Construction		██████████				
O&M				██████████	██████████	██████████
<b>Environment Management Activities</b>						
<i>Participatory Land Acquisition Planning (Main and Secondary Facilities)</i>						
- Preparation of Draft Land Acquisition Plan among MOWRAM through consultation with IRC						
- Stakeholder Workshop	△	△				
- Socio-economic Survey		△				
- Valuation of Affected Asset		△				
- Compensation		△				
- Monitoring			██████████			
<i>Participatory Tertiary Development</i>						
- Establishment of Local-based Organization for Compensation	△					
- Preparation of Draft Land Acquisition Plan		△				
- Socio-economic survey		△				
- Stakeholder Workshop		△				
- Finalization of Compensation		△				
- Implementation of tertiary development			██████████			
<i>Education Program for Construction Labor</i>						
- Clause for the provision of appropriate base camp						
- Stakeholder Workshop		△				
- Education Program for Labor organized by the Contractor		△	△	△		
- Monitoring			██████████			
<i>Construction of Fish Ladder</i>						
- Survey of biological and physiological characteristics of migrating species						
- Judgment of Necessity	△					
- Design		△				
- Construction			██████████			
- Monitoring of its Effectiveness and Rectification, if any				██████████		
<i>Environmental Consideration in Technical Specification for Construction Works</i>						
- Preparation of Tender Document						
- Tendering			△			
- Monitoring				██████████		
<i>System O&amp;M and Water Management Improvement</i>						
<b>System O&amp;M</b>						
- Awareness Program		△				
- Establishment of FWUC		△				
- Preparation of FWUC By-Laws		△				
- O&M Planning						
- Establishment of O&M Fund						
- Implementation of System O&M						
- Monitoring					██████████	
<b>Water Management</b>						
- Awareness Program			△			
- Training of Water Management through the Application of Improved Water Management						
- Regular Monitoring of Water Management					██████████	
<i>Appropriate Application of Agricultural Input in parallel with Agricultural Support Activities</i>						
- Agriculture Support Program						
- Water Quality Monitoring			△	△	△	△
- Soil Quality Monitoring			△	△	△	△

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**Tentative Timeframe of Environment Management Activities (Lum Hach Sub-Project)**

## CHAPTER 8 COMPARISON BETWEEN WITH AND WITHOUT PROJECT

### 8.1 Comparison Between “With” and “Without” Conditions

Comparison of “With” and “Without” projects proposed is tabulated as follows:

**Comparison between “With” and “Without” Conditions**

Aspect	Without Projects	With Projects
Resource Mobilization (Water and Land)	<ul style="list-style-type: none"> <li>Irrigation water is quite limited.</li> <li>Ineffective resource utilization for irrigation is practiced through ineffective irrigation water management, poor O&amp;M of facilities with insufficient support.</li> </ul>	<ul style="list-style-type: none"> <li>Irrigation water increase for agriculture through permanent intake weir and rehabilitated canals.</li> <li>Meteo-hydrological monitoring system is strengthened so as to prepare effective irrigation service plan and to effectively carry out river basin management.</li> <li>Overall, effective resource mobilization for irrigation sector is materialized.</li> </ul>
Agriculture	<ul style="list-style-type: none"> <li>Cropping area under the Lum Hach Sub-project is only 200 ha with limited irrigation water as supplemental irrigation.</li> <li>Paddy yield remains low ranging from 1.5 t/ha (rainfed condition) to 3.0 t/ha (irrigated condition).</li> <li>Upland farming is negligibly small.</li> </ul>	<ul style="list-style-type: none"> <li>Cropping area under the Sub-Project increases to 3,100 ha with irrigated conditions, therefore, agricultural productivity increase.</li> <li>Yield is expected to reach 3.5 t/ha under normal irrigated conditions contributing to increase of farmers’ income.</li> <li>Upland farming is introduced contributing to the promotion of value-added agriculture.</li> </ul>
Institution	<ul style="list-style-type: none"> <li>There is no FWUC in the command area. In addition, no substantial group activities for water management exist at present.</li> <li>O&amp;M of irrigation systems through group collaborative action is still not observed.</li> </ul>	<ul style="list-style-type: none"> <li>FWUCs are established at each irrigation system for carrying out O&amp;M through supporting program.</li> <li>Coordination among local organizations is expected to be strengthened to utilize effective resource mobilization.</li> </ul>

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### 8.2 Comparison of Potential Negative Impacts Between “With” and “Without” Project

Potential negative environmental impacts are analyzed under “With” and “Without” Projects implementation as summarized in the table below:

**Comparison of Potential Negative Impact between “With” and “Without” Projects**

Potential Impact	Without	With	Remarks
Social Environment			
1 Involuntary Resettlement	X	-/C	Land acquisition necessary for construction of main, secondary and tertiary facilities
2 Local Economy (Employment and Income Generation)	-/A	+/A	Effective resource use materialization with better irrigation O&M
3 Land Use and Resource Mobilization	-/A	+/A	Irrigation water increase
4 Social capital and Traditional Institutions	-/A	+/A	Improved by means of FWUC support program

Potential Impact	Without	With	Remarks
5 Social Infrastructure and Services	-/A	+/A	Improved irrigation rehabilitation
6 The poor, indigenous and minority group	-/A	X	Population pressure in future
7 Unequal Distribution of Damage and Benefit	-/A	X	Population pressure in future
8 Cultural Heritage	X	X	No cultural heritage in and/or around the command area
9 Local conflict over interest	-/A	+/A	Effective resource use if mitigation measures are properly carried out
10 Water Use	-/A	+/A	Irrigation water increase by rehabilitated facilities
11 Sanitation	X	X	
12 Risk against infectious diseases	X	X	No significant impact if mitigation measures are carried out
Natural Environment			
13 Topography and Geographical Features	X	X	
14 Soil Erosion	-/B	+/A	Mitigated particularly by regulating water by new headworks and rehabilitated facilities
15 Groundwater	X	X	
16 Hydrology	X	X	
17 Coastal Area such as Mangrove, Coral Reef and Tidal Area	X	X	
18 Flora, Fauna and Biodiversity	X	X	
19 Meteorology	X	X	
20 Landscape	X	X	
21 Global Warming	X	X	
Pollution			
22 Air Pollution	X	-/C	During construction although small impact
23 Water Pollution	X	-/C	During construction although small impact
24 Soil Contamination	X	-/C	During construction although small impact
25 Waste	X	-/C	During construction although small impact
26 Noise and Vibration	X	-/C	During construction although small impact
27 Ground Subsidence	X	X	
28 Offensive Odor	X	X	
29 Sedimentation	X	X	
30 Accidents	X	-/C	During construction

Note: - : Adverse Impact X: No Impact +: Positive Impact  
A: Great Impact B: Medium Impact C: Small Impact

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Without implementing the Lum Hach sub-project, the livelihood of the people will most likely continue at their present levels. Each time the fertility of the plot of land comes to unproductive levels excessive intensity of production if future population pressure is considered. The implementation of the sub-project will mitigate the present instability in farming by providing irrigation water through rehabilitated facilities. It will make way for

farming in more stabilized manner, improve living standards and provide additional income. It will gradually bring about a balance in resource use and reduce land degradation.

Producing sufficient rice for domestic consumption is a priority policy of the government of Cambodia. Food security will be improved through increasing rice production which is one of the more important objectives of the sub-project.

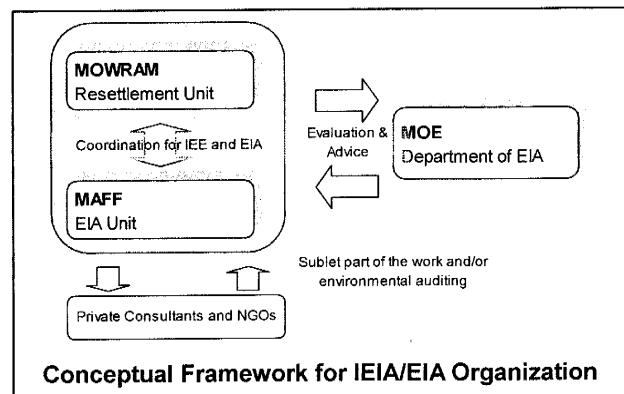
## CHAPTER 9 STRENGTHENING OF INSTITUTIONAL CAPACITY FOR ENVIRONMENTAL MANAGEMENT

### 9.1 Organizational Structure

The Strategic Development Plan 2006-2010 (Draft) has accentuated the importance of “having a comprehensive capacity to develop and apply procedures for social and environmental impact assessment and mitigation” as shown in MOWRAM Goal 11.<sup>4</sup> At present, Resettlement Unit is in charge of handling social environmental impact particularly resettlement issues associated with irrigation development projects under MOWRAM. However, practical knowledge and experience in Environmental Impact Assessment (EIA) and environmental management remains limited.

In order to properly carry out EIA, prepare environmental management plan and pursue its implementation for irrigation development in the future, coordination is required between the Resettlement Unit under MOWRAM

and EIA unit of MAFF. In addition, out-sourcing of the part of EIA work to private consulting firm should be also considered.



### 9.2 Capacity Development Plan for Environmental Management

Strengthening the staff capability of MOWRAM, PDOWRAM and village authorities in terms of environmental awareness and practical impact mitigation measures through in-service training and study visits to model areas would be important and beneficial for sustainable irrigation development and management for the Lum Hach rehabilitation sub-project. Training models such as cascading style of training where trainees at one level become trainers at the other level, and the mechanism for information shares and feedback from lower to higher levels is evident. These activities will create a different kind of institutional organization and communities which has the capacity to retain its abilities to facilitate, as well as to respond to environmental awareness and management. Training programs proposed for environmental management is as follows:

- (1) On-the-Job Training for IEIA and preparation of TOR for EIA
  - To understand procedure of IEIA and EIA on the basis Sub-Decree on Environmental Impact Assessment Process

<sup>4</sup> Planning and International Cooperation Department, MOWRAM (2005), Strategic Development Plan 2006-2010 (Draft of 23 May, 2005)

- To carry out basic field environmental survey such as field interview, on-site water and soil sampling and quality analysis etc.
  - To develop IEIA capabilities through case studies of irrigation projects
  - To visit construction sites of irrigation development project
  - To prepare checklist for IEIA and carry out IEIA based on checklist
  - To execute training program and seminar for strengthening staffs' capabilities on the preparation of Terms of Reference (TOR) for EIA
- (2) Training for Environmental Impact Mitigation and Management Planning
- To clarify causal relation of environmental impact from irrigation development
  - To prepare appropriate management plan of adverse environmental impact
  - To prepare environmental monitoring and evaluation plan

## CHAPTER 10 CONCLUSIONS

From the field studies, other information gathered and discussion presented in the preceding chapters, it is concluded that the Lum Hach Sub-project will be extremely beneficial to the communities living in the command area. There will be a better productivity and an improved livelihood if the project is to be implemented.

No serious adverse environmental impacts are predicted for the Lum Hach rehabilitation sub-projects since the sub-project is existing one and no large scale of expansion and/or new development is included under the component. Those adverse environmental impact identified are of a minor nature. Mitigation and enhancement measures are suggested where necessary and these will bring about an overall improvement in environmental quality. Indeed, once completed, well managed sub-project should enhance the long-term sustainability of the rural environment.

In view of the above conclusions arising out of the IEIA of the sub-projects, a full scale Environmental Impact Assessment (EIA) is not considered necessary.



## *Tables*

**Table 4.3.1 Result of Poverty Ranking at Lum Hach Irrigation Sub-Project (Boribo River Basin)**

Classification	Number of Family	Percentage	1. Income		2. Asset				3. Education Level	4. Basic Human needs Satisfaction	5. Financial Transaction Experience	
			Average Income per month (Riels)	Source of Income (main economic activity)	Land (ha)	Bicycles, motorcycles, cars, truck, tractors, etc.	TV, music, player, video, radio, etc	Livestock				
Destitute	10F	9%	0-200	Labor	1	Nothing	Nothing	Nothing	0-2 chicken	Adult	(food-rice)	Banks, farmer's group, money lenders, middlemen, pawnshop, etc..
Poor	56F	50%	200-500	Land owner farmer, Labor out of village	1 - 1.5	Bicycle, cart	Radio	Radio	5-10 chicken 1 Cow 1-2 pigs	Primary school drop-out	enough for 2 months	Can't lend money and debt from neighbor
Fair	42F	37%	500-1500	Land owner farmer	1.5 - 5	Bicycle, cart	Radio, Back and white TV	Radio, Back and white TV	20-30 chicken 2-5 Cow 2-3 Pigs	Primary school	enough	Have money to lend to neighbor and can lend money from the bank
Rich	4F	4%	>1500	Land Owner, Trader	>5	Bicycle, cart, Motorbike, Engine cart	rice miller, Radio, Color TV, VCD	rice miller, Radio, Color TV, VCD	>30 chicken >10 Cow >10 Pigs	Primary and Secondary school	more than enough	have money to lend to neighbor, group saving, can lend money from the bank
Total	112F	100%										

**Table 5.2.1 Summary of Discussion on PIMD made in the Public Meeting at Lum Hach Irrigation Sub-Project (1/2)**

Question	Khun Rong	Pech Changvar	Melom	Anchanh Rung
How will you organize FWUC? Who will be a prospective leader of FWUC?	<ul style="list-style-type: none"> <li>• First Deputy Commune Chief who is presently responsible for finance would be a prospective leader for future FWUC.</li> <li>• It shall be necessary to select through the election.</li> <li>* At present, the board of Khun Rong Commune Council consist one (1) Chief and two (2) Deputy Chief (Finance and Security).</li> </ul>	<ul style="list-style-type: none"> <li>• A prospective leader for FWUC would be selected from a member of commune council.</li> <li>• It shall be necessary to select through the election.</li> </ul>	<ul style="list-style-type: none"> <li>• Criteria for the leader of FWUC is not clear at the moment.</li> <li>• The leader should be selected by organizing a meeting among community members as well as election.</li> </ul>	<ul style="list-style-type: none"> <li>• A prospective leader should be the one in the upstream of the Project.</li> <li>• It shall be necessary to select through the election.</li> </ul>
Who can be a member of FWUC?	<ul style="list-style-type: none"> <li>• Member of FWUC would consist of (i) village chief and (ii) Village Development Committee (VDC) and (iii) farmer with rice field under Lum Hach Project.</li> </ul>	<ul style="list-style-type: none"> <li>• FWUC member will include farmers with their under the canal system of Lum Hach Project.</li> </ul>	<ul style="list-style-type: none"> <li>• All members under the command area of Lum Hach Project would be authorized to be members of FWUC.</li> </ul>	<ul style="list-style-type: none"> <li>• FWUC member will include farmers with their under the canal system of Lum Hach Project.</li> </ul>
If irrigation system covers several communes, how will you organize FWUC?	<ul style="list-style-type: none"> <li>• It will be necessary to organize federation in collaboration with Phsar and Anchanh Rung commune.</li> </ul>	<ul style="list-style-type: none"> <li>• All villages of communes under the command area of the Project should participate in the establishment of FWUC.</li> </ul>	<ul style="list-style-type: none"> <li>• It is required to organize water distribution committee to cover all villages and communes.</li> </ul>	<ul style="list-style-type: none"> <li>• It shall be necessary to establish maintenance committee in village.</li> </ul>
What kind of activities do you think required for FWUC in your project? Please explain using system layout prepared	<ul style="list-style-type: none"> <li>• FWUC activities would include: promotion of participate in maintenance of facilities by members for their sustainability.</li> <li>• In addition, facilitation of farmers' to pay water fee on the basis of amount to be agreed.</li> </ul>	<ul style="list-style-type: none"> <li>• FWUC activities consist of (i) prevention of any conflict based on the regulation to be established.</li> </ul>	<ul style="list-style-type: none"> <li>• FWUC activities include: (i) repair the canal, (ii) dig a new canal and build water gate, and (iii) build dam to store water.</li> </ul>	<ul style="list-style-type: none"> <li>• Canal maintenance is one of the most important activities for FWUC.</li> </ul>

**Table 5.2.1 Summary of Discussion on PIMD made in the Public Meeting at Lum Hach Irrigation Sub-Project (2/2)**

Question	Popel	Kraing Skear	Prasneb	Phsar
How will you organize FWUC? Who will be a prospective leader of FWUC?	<ul style="list-style-type: none"> <li>A prospective leader would be either village chief or commune chief to be selected by election.</li> </ul>	<ul style="list-style-type: none"> <li>Criteria for prospective leader is "Active person who can struggle difficulties."</li> <li>The leader should be selected by election.</li> </ul>	<ul style="list-style-type: none"> <li>Members of committee should be elected by the people in the community, member of which has at least 7.</li> <li>A leader shall be elected by the people in village and commune.</li> </ul>	<ul style="list-style-type: none"> <li>A leader should be elected from commune chief of either Anchanh Rung Commune or Pech Changvar Commune since these two communes are located in the upstream of the Project.</li> </ul>
Who can be a member of FWUC?	<ul style="list-style-type: none"> <li>Members of FWUC are Farmers having rice field under Lum Hach irrigation Project.</li> </ul>	<ul style="list-style-type: none"> <li>Members of FWUC are farm families getting water from reservoir of Lum Hach Irrigation Project.</li> </ul>	<ul style="list-style-type: none"> <li>Members of FWUC are such people as in the village and the commune having field under the Project.</li> </ul>	<ul style="list-style-type: none"> <li>Farmers with their field under the Project are eligible to be members of FWUC.</li> </ul>
If irrigation system covers several communes, how will you organize FWUC?	<ul style="list-style-type: none"> <li>It shall be necessary to organize general committee to carry out supervision of all the villages' activities.</li> </ul>	<ul style="list-style-type: none"> <li>Establish regulation, contract and relation from one village to another village and one commune to another commune for good cooperation</li> </ul>	<ul style="list-style-type: none"> <li>It shall be necessary to organize a committee to properly manage water use among communes concerned.</li> </ul>	<ul style="list-style-type: none"> <li>Villages under the Lum Hach Project need to coordinate together to establish Federation.</li> </ul>
What kind of activities do you think required for FWUC in your project? Please explain using system layout prepared	<ul style="list-style-type: none"> <li>FWUC activities consist of: (i) preparation of a regulation and (ii) contact with authority to get support for the activities.</li> </ul>	<ul style="list-style-type: none"> <li>FWUC activities should be (i) to organize groups, (ii) preparation of a regulation, (iii) introduce members about work needs to be done as a group.</li> <li>In addition, FWUC need to give information on climate condition during cropping season, particularly drought in advance, and provide farmers with countermeasures against drought.</li> </ul>	<ul style="list-style-type: none"> <li>Most important FWUC's activity is to manage irrigation water through facilitating participation of the community members.</li> <li>To do so, regulation must be prepared in consideration of beneficiaries' needs.</li> </ul>	<ul style="list-style-type: none"> <li>Labor Force and budget are absolutely needed to establish and strengthen FWUC.</li> </ul>

**Table 6.1.1 Environmental Impact Matrix of Lum Hach Irrigation Sub-Project (1/2)**

Item	Stage and Impact			Reason	Mitigation Measures	Monitoring	
	Preparation	Construction	O&M			Method	Timing
<b>Social Environment</b>							
1. Involuntary Resettlement	-/C	X	X	<ul style="list-style-type: none"> <li>No significant impact will be expected since there is no large scale new expansion of the area.</li> <li>Land acquisition necessary for the sub-project is in the upstream of proposed headworks. Total submerged area and affected household is estimated to be 143 ha and ??? households respectively with El. 39 m although all the houses are illegal built in state-property area.</li> <li>Illegal farming and/or fishing activities within existing canal area must be considered for land acquisition.</li> <li>Land acquisition is needed also for main and secondary canal expansion and new construction.</li> </ul>	<ul style="list-style-type: none"> <li>This issue must be considered from the preparation phase of the sub-project. Stage-wise discussion is required on canal alignment, compensation measures, support programs and so forth, which contribute to maintain living condition of farmers. <i>(Main and Secondary Facilities: Participatory Land Acquisition Planning) (Tertiary Facilities: Participatory Tertiary Development)</i></li> </ul>	<ul style="list-style-type: none"> <li>Workshop, Stakeholder meeting</li> </ul>	<ul style="list-style-type: none"> <li>Preparation, Construction and O&amp;M Phase</li> </ul>
2. Local Economy (Employment and Income Generation)	X	+/B	+/B	<ul style="list-style-type: none"> <li>New job opportunity from construction works as well as agricultural production enhancement by irrigation will give positive impact in the community.</li> </ul>	-	<ul style="list-style-type: none"> <li>Socio- economic survey</li> </ul>	<ul style="list-style-type: none"> <li>O&amp;M Phase</li> </ul>
3. Land Use and Resource Mobilization	X	X	+/B	<ul style="list-style-type: none"> <li>Large scale area-wise expansion is not included by this plan, therefore, there will be no significant adverse impact in land use and resource mobilization. Instead, positive impact will be expected by intensified farming through improved water use.</li> </ul>	-	<ul style="list-style-type: none"> <li>Socio- economic survey</li> </ul>	<ul style="list-style-type: none"> <li>O&amp;M Phase</li> </ul>
4. Social capital and Traditional Institutions	X	X	X	<ul style="list-style-type: none"> <li>No significant impact will be anticipated.</li> </ul>	-	-	-
5. Social Infrastructure and Services	X	X	X	<ul style="list-style-type: none"> <li>No significant impact will be anticipated.</li> </ul>	<ul style="list-style-type: none"> <li>Layout and network of canals, drains and road should be determined by possibly considering existing conditions. In addition, canal crossing structures needs to be considered wherever necessary for the maintenance of social network. <i>(Main and Secondary Facilities: Participatory Land Acquisition Planning) (Tertiary Facilities: Participatory Tertiary Development)</i></li> </ul>	-	-
6. The poor, indigenous and minority group	X	X	X	<ul style="list-style-type: none"> <li>No impact will be expected.</li> </ul>	-	-	-
7. Unequal Distribution of Damage and Benefit	-/C	X	X	<ul style="list-style-type: none"> <li>The proposed headworks will create submerged areas in the upstream extending 143 ha (??? households). Without appropriate land acquisition and compensation process, farmers with irrigated field in the downstream would take benefit as planned while farmers in the upstream would suffer damage from the sub-project implementation.</li> <li>Tertiary facilities construction would, in addition, affect existing field. Consensus building should be carefully carried out among farmers to promote tertiary development.</li> </ul>	<ul style="list-style-type: none"> <li>The mitigation measures for this issue will be generally taken in the similar manner of main and secondary canals by participatory approach with the assistance of MOWRAM and IRC. <i>(Main and Secondary Facilities: Participatory Land Acquisition Planning)</i></li> </ul>	<ul style="list-style-type: none"> <li>Workshop, Stakeholder meeting</li> </ul>	<ul style="list-style-type: none"> <li>Preparation Phase</li> </ul>
8. Cultural Heritage	X	X	X	<ul style="list-style-type: none"> <li>No impact will be expected since no cultural heritage exists in the command area of the sub-project.</li> </ul>	-	-	-
9. Local conflict over interest	X	-/C	-/C	<p><u>Construction</u></p> <ul style="list-style-type: none"> <li>Due to the inflow of construction labors from outside, conflict among labors and farmers are expected leading to security deterioration in the community.</li> </ul> <p><u>O&amp;M</u></p> <ul style="list-style-type: none"> <li>Conflict over unequal water use would possibly be anticipated within the sub-project command area if water distribution is unorganized.</li> </ul>	<ul style="list-style-type: none"> <li>Education programs are necessary for both labors and community members to raise awareness so as to maintain security in the community during construction. <i>(Education Program for Construction Labor)</i></li> <li>FWUCs should be established and strengthened to prepare irrigation service plan and to carry out its implementation. Group management skills are also necessary to share common goods in equitable manner. <i>(FWUC Establishment and Strengthening)</i></li> </ul>	<ul style="list-style-type: none"> <li>Education Programs</li> <li>FWUCs strengthening program</li> </ul>	<ul style="list-style-type: none"> <li>Construction Phase</li> <li>Design, Construction and O&amp;M Phase</li> </ul>
10. Water Use	X	-/C	+/A	<p><u>Preparation</u></p> <ul style="list-style-type: none"> <li>No significant impact will be anticipated. River water use for other sectors needs to be re-checked in the preparation stage.</li> </ul> <p><u>Construction</u></p> <ul style="list-style-type: none"> <li>Water flow is affected by the construction of headworks. Water supply for both drinking and agriculture needs to be considered during construction stage although percentage of the River water user under the sub-project is comparatively lower.</li> </ul> <p><u>O&amp;M</u></p> <ul style="list-style-type: none"> <li>Water resource utilization will be expected to be effectively carried out through the sub-project.</li> </ul>	<ul style="list-style-type: none"> <li>Construction schedule is prepared taking cropping schedule under the command area into account. Drinking water is provided by alternative ways such as water tank truck.</li> <li>Such issues are clearly specified in the technical specification of the construction works. <i>(Environmental Consideration in Technical Specification for Construction Works)</i></li> </ul>	<ul style="list-style-type: none"> <li>Stakeholder Meeting</li> </ul>	<ul style="list-style-type: none"> <li>Construction Phase</li> </ul>
11. Sanitation	X	-/C	X	<ul style="list-style-type: none"> <li>This would happen due to inflow of labors from outside during construction stage.</li> </ul>	<ul style="list-style-type: none"> <li>It is important for Contractors to prepare proper accommodation with sanitary facilities including toilet and water supply for construction labors. Education and training program is also required to raise awareness of labors for the maintenance of sanitary conditions in and around the sub-project site. <i>(Environmental Consideration in Technical Specification for Construction Works) &amp; (Education Program for Construction Labor)</i></li> </ul>	<ul style="list-style-type: none"> <li>Site Supervision</li> </ul>	<ul style="list-style-type: none"> <li>Construction Phase</li> </ul>
12. Risk against infectious diseases	X	-/C	X	<ul style="list-style-type: none"> <li>This would happen due to inflow of labors from outside during construction stage.</li> </ul>	<ul style="list-style-type: none"> <li>This also requires education program to raise awareness among construction labors. <i>(Education Program for Construction Labor)</i></li> </ul>	<ul style="list-style-type: none"> <li>Stakeholder Meeting</li> <li>Site Supervision</li> </ul>	<ul style="list-style-type: none"> <li>Construction Phase</li> </ul>

**Table 6.1.1 Environmental Impact Matrix of Lum Hach Irrigation Sub-Project (2/2)**

Item	Stage and Impact			Reason	Mitigation Measures	Monitoring	
	Preparation	Construction	O&M			Method	Timing
<b>Natural Environment</b>							
13. Topography and Geographical Features	X	X	X	• No impact will be expected in this matter.	-	-	-
14. Soil Erosion	X	X	+/B	• Soil erosion will be mitigated by regulating water flow by the headworks and drainage improvement.	-	-	-
15. Groundwater	X	X	X	• No impact will be expected in this matter.	-	-	-
16. Hydrology	X	X	X	• No impact will be expected in this matter.	-	-	-
17. Coastal Area such as Mangrove, Coral Reef and Tidal Area	X	X	-/C	• Increase in chemical and fertilizer by carrying out irrigated agriculture using rehabilitated facilities would affect water quality of the Tonle Sap.	• In order to avoid excessive utilization of fertilizer and chemicals, some supporting programs are essential such as introduction of integrated pest management (IPM). ( <i>FWUC Establishment and Strengthening</i> )	• Site reconnaissance • Water Quality Sampling and Analysis	• O&M Phase
18. Flora, Fauna and Biodiversity	X	-/C	-/C	• Rehabilitation of existing facilities would affect existing biotope particularly fish sprawling in the Boribo River by the construction of the Lum Hach Headworks.	• Although direct beneficiaries of the sub-project are farmers engaging in irrigated agriculture, construction schedule should be prepared considering fish spawning habitat as well as fishing season of fish farmers surrounding sub-project. • In addition, facilities design needs to consider fish habitat. Construction of fish ladder with intake weir is one of the effective mitigation measures. ( <i>Construction of Fish Ladder</i> )	• Site Reconnaissance	• Construction and O&M Phase
19. Meteorology	X	X	X	• No impact will be expected.	-	-	-
20. Landscape	X	X	X	• No impact will be expected.	-	-	-
21. Global Warming	X	X	X	• No impact will be expected.	-	-	-
<b>Pollution</b>							
22. Air Pollution	X	-/C	X	• Not more than serious impact will be expected since structures under the plan are not large scale. But machinery use during the construction shall be considered.	• During earth works, it is effective to provide sprinkling to mitigate dust. In addition, reducing idling time of construction machinery is essential to minimize exhaust gas from construction machinery. ( <i>Environmental Consideration in Technical Specification for Construction Works</i> )	• Training of operators for construction machinery	• Construction Phase
23. Water Pollution	X	-/C	-/C	<u>Construction</u> • Increase of waste water will possibly happen due to inflow of labor for construction. <u>O&amp;M</u> • Inappropriate use of chemical and fertilizer would increase to affect water quality if farming improvement and extension is not properly carried out.	• Education programs should be carried out for construction labors to raise their awareness on proper disposal treatment. ( <i>Education Program for Construction Labor</i> ) • In addition, technical specification of the construction works should involve mitigation measures on environmental impact including construction waste disposal. ( <i>Environmental Consideration in Technical Specification for Construction Works</i> )	• Water sampling • Quality analysis	• Design and Construction Phase
24. Soil Contamination	X	X	-/C	• Misuse and/or excessive use of fertilizer would contaminate soil in command area under irrigation system.	• In order to avoid excessive utilization of fertilizer and chemicals, some supporting programs are essential such as introduction of integrated pest management (IPM). ( <i>FWUC Establishment and Strengthening</i> )	• Soil sampling and analysis	• O&M Phase
25. Waste	X	-/C	X	• Waste from construction would be expected.	• As well as mitigation of water pollution, education programs should be carried out for construction labors to raise their awareness on proper disposal treatment. In addition, technical specification of the construction works should involve mitigation measures on environmental impact including construction waste disposal. ( <i>Education Program for Construction Labor</i> )	• Site Supervision	• Construction Phase
26. Noise and Vibration	X	-/C	X	• Although it would be not significant, noise and vibration by the use of vehicles and construction machineries shall be considered.	• Working hour needs to be agreed through stakeholder meetings so as not to disturb living condition of communities. ( <i>Environmental Consideration in Technical Specification for Construction Works</i> ) & ( <i>Education Program for Construction Labor</i> )	• Site Supervision	• Construction Phase
27. Ground Subsidence	X	X	X	• No impact will be expected since no large scale new facilities are proposed under the development plan. In addition, scooping up of great amount of groundwater will not be carried out in the construction works.	-	-	-
28. Offensive Odor	X	X	X	• No impact will be expected.	-	-	-
29. Sedimentation	X	X	X	• No impact will be expected.	-	-	-
30. Accidents	X	-/C	X	• This would be the concern due to the increase of vehicles and construction machineries during construction stage.	• This would be due to increase of vehicle and construction machinery during construction stage. ( <i>Education Program for Construction Labor</i> )	• Site Supervision	• Construction Phase

Note

- : Adverse Impact,
- X : No Impact
- + : Positive Impact
- A : Great Impact
- B : Medium Impact
- C : Small Impact

## *Figures*

# SOIL MAP OF BORIBO RIVER BASIN

Basin-wide Basic Irrigation and Drainage Master Plan Study  
in the Kingdom of Cambodia  
JICA Japan International Cooperation Agency (JICA)

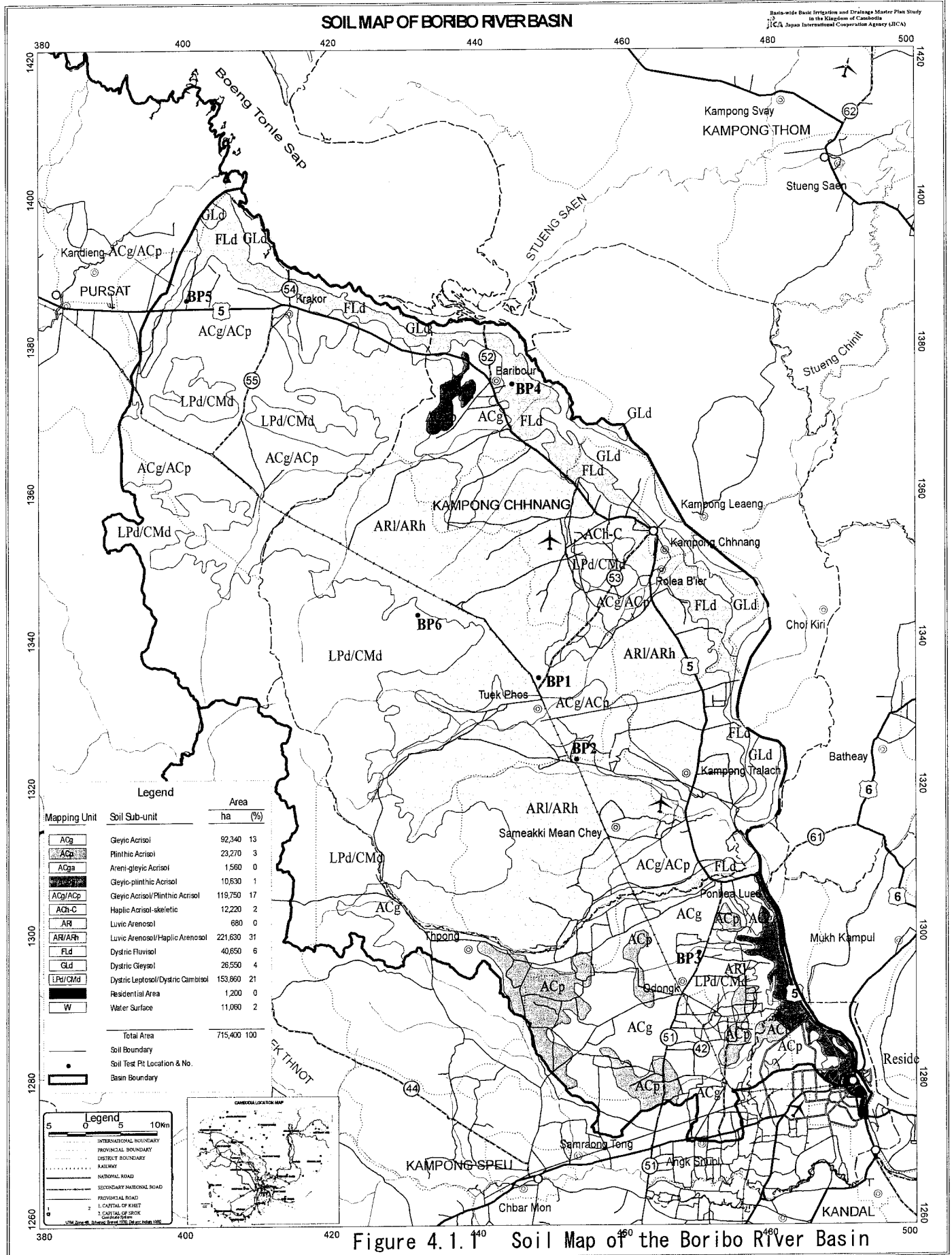
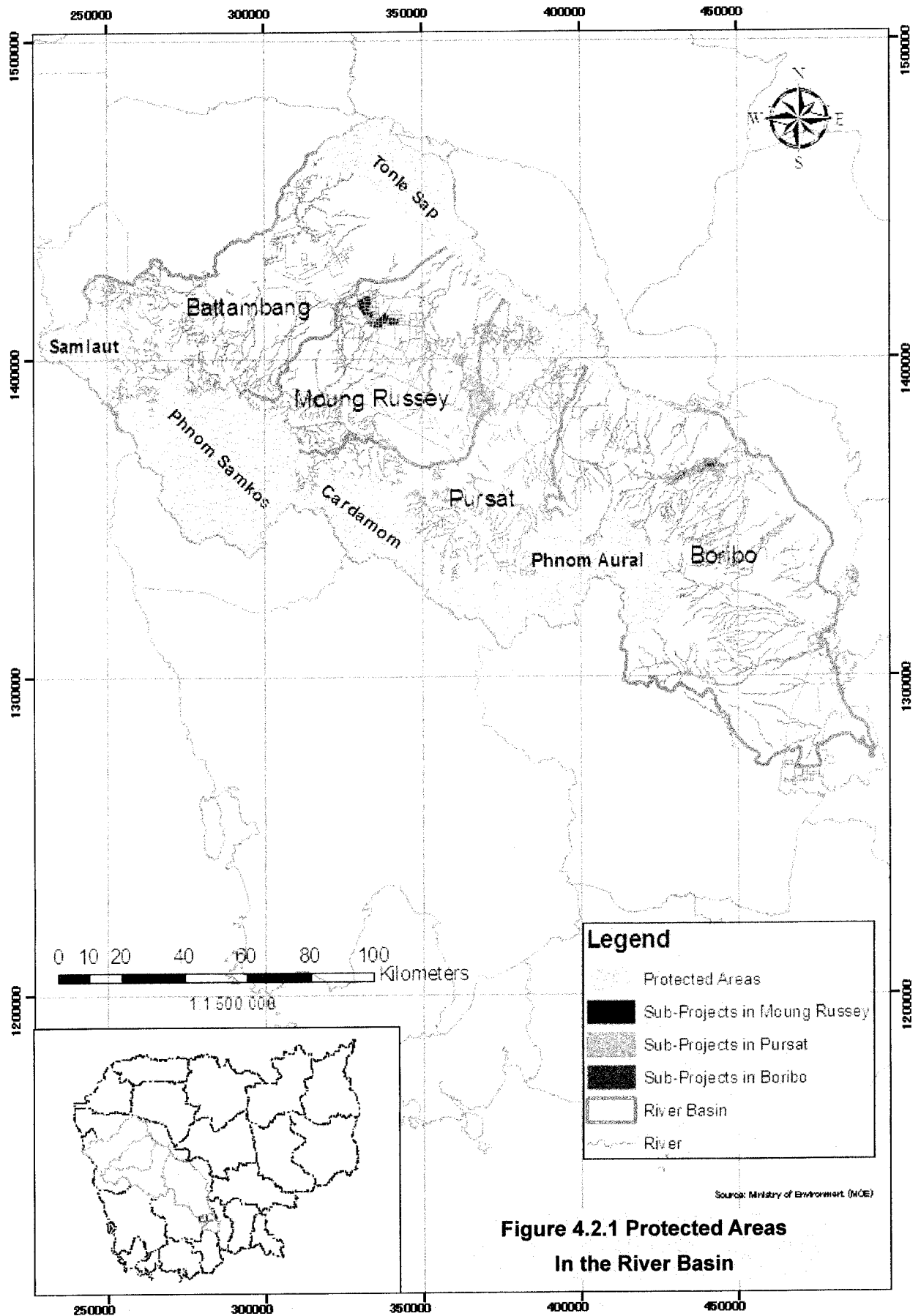


Figure 4.1.1 Soil Map of the Boribo River Basin

Source: Soil map prepared by the Tonle Sap Stabilization Project, ADB, 2006



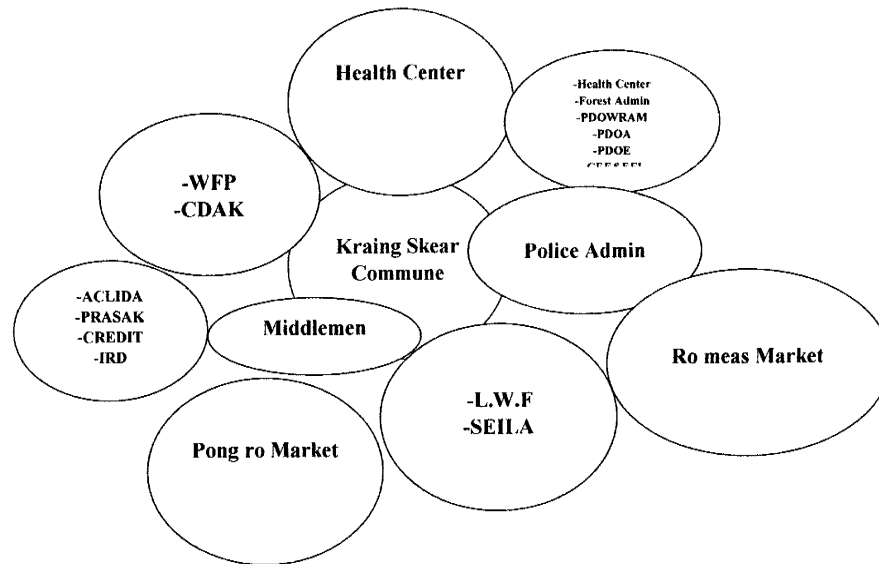


**Figure 4.2.1 Protected Areas  
In the River Basin**

List of Institutions, its influence and physical distances, refer following Table of Kraing Skear Commune (Group-3)

Gov.	Institutional	Influence	Physical distances
		Large, moderate or small	Near, moderate or far
G-1	Health Center	Big	Near
G-2	Forestry administration	Big	Far
G-3	Provincial of Agriculture	Fair	Moderate
G-4	PDOWRAM	Fair	Moderate
G-5	Provincial of Environment	Fair	Far
G-6	Community of forestry (EEC and CFI)	Fair	Far
<b>Private</b>			
P-1	PONGRO Market	Fair	Moderate
P-2	ROMEAS Market	Fair	Moderate
P-3	KHDOL Market	Fair	Moderate
P-4	Middlemen	Fair	Near
<b>Credit</b>			
C-1	ACLIDA	Fair	Moderate
C-2	CREDIT	Fair	Moderate
C-3	PRASAC	Fair	Moderate
C-4	KANGREY	Fair	Moderate
C-5	IRD	Fair	Moderate
<b>NGO</b>			
N-1	WFP Organization	Fair	Near
N-2	LW F Organization	Big	Moderate
N-3	Seila Organization	Big	Moderate
N-4	CDAK Organization	Fair	Moderate

Institutions Linkage Map of Kraing Skear Commune (Group-3)



Note: ○ Gov. Institutionals  
 ○ Private/Business  
 ○ Rural Credit  
 ○ NGO

Figure 5.1.1 Institutional Linkage Map of Kraing Skear Commune

Flow Chart on Production Market Process of Kraing Skear Commune (Group-3)

Gov.	Institutional	Influence	Physical distances	Characteristics and transaction
		Large, moderate or small	Near, moderate or far	
G-1	Health Center	Big	Near	Provide medicine + Hospitalized
G-2	Forestry administration	Big	Far	Establish community
G-3	Provincial of Agriculture	Fair	Moderate	Provide Agric technology, Fertilizers, Crops, Breedbird flue training
G-4	PDOWRAM	Fair	Moderate	-Dam and Canal repairing
G-5	Provincial of Environment	Fair	Far	Establish community
G-6	Community of forestry (EEC and CFI)	Fair	Far	Others vocational training
<b>Private</b>				
P-1	PONGRO Market	Fair	Moderate	Agricultural production trade -Buy Agricultural + construction Equipments
P-2	ROMEAS Market	Fair	Moderate	Agricultural production trade
P-3	KHDOL Market	Fair	Moderate	
P-4	Middlemen	Fair	Near	Buy Pig, Cow, Buffalo, Chicken, Rice-Carpenter: Table, Cupboard, Chair, Door, Window (Cheep per then Pong ro Market 3%)
<b>Credit</b>				
C-1	ACLIDA	Fair	Moderate	Borrowing and Lending
C-2	CREDIT	Fair	Moderate	Mortgage's rice-field Rate 2-3% per month
C-3	PRASAC	Fair	Moderate	Borrower had fidelity
C-4	KANGREY	Fair	Moderate	Have an agreement
C-5	IRD	Fair	Moderate	Eye witness & Authorized by local authority
<b>NGO</b>				
N-1	WFP Organization	Fair	Near	Provided breeds: Pigs, Cows, Hens, Crops, Group Saving Cooperation with and Establish forestry community -Provide Agric equipments Children health care, Touching Gender Family violence and vocational training.
N-2	CDAK Organization	Fair	Near	Provided breeds: Pigs, Cows, Hens, Crops, Group Saving Cooperation with and Establish forestry community -Provide Agric equipments Children health care, Touching Gender Family violence and vocational training.
N-3	Seila Organization	Big	Near	Provide Infrastructure, local salary 37 Mills Riels per year
N-4	LWF Organization	Big	Near	Provide 9Wells and 7dick wells and 4Latrines, will provide for next 5 years

Flow Chart on Production Market Process of Kraing Skear Commune (Group-3)

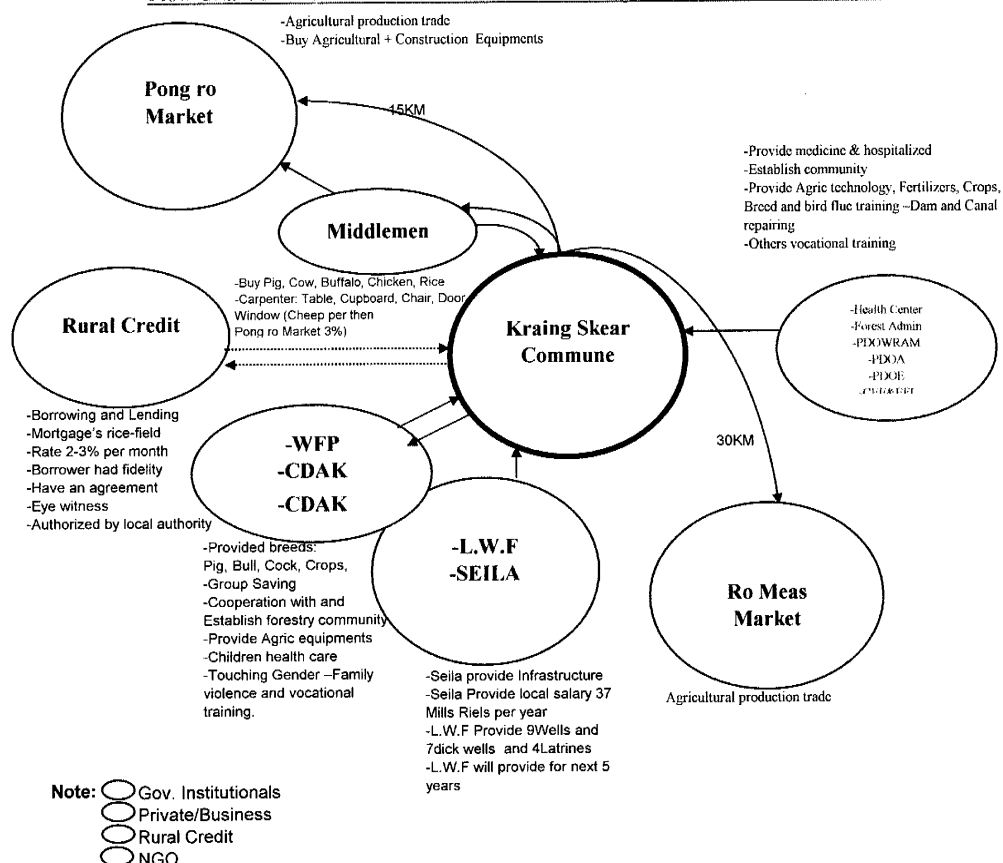


Figure 5.1.2 Production-Marketing Flow Process of Kraing Skear Commune

List of Institutions, its influence and physical distances.  
refer following Table of Melum Commune (Group-5)

Gov.	Institutional	Influence	Physical distances
		Large, moderate or small	Near, moderate or far
G-1	Health Center	Big	Near
G-2	Provincial of Youth and Education	Big	Moderate
G-3	PDOWRAM	Fair	Moderate
G-4	Provincial Social Affair	Fair	Moderate
G-5	Provincial of Women Affair	Fair	Moderate
G-6	Provincial of Agriculture	Fair	Moderate
G-7	Police of Administration	Fair	Near
G-8	Commune of Veterinary	Small	Near
G-7	Forestry Administration (Section)	Fair	Moderate
<b>Private</b>			
P-1	Boribo Market	Fair	Moderate
P-2	Middlemen	Fair	Near
<b>Credit</b>			
C-1	ACLIDA	Small	Moderate
C-2	CREDIT	Small	Moderate
C-3	PRASAC	Small	Moderate
C-4	AMK	Small	Moderate
C-5	VISION FUND	Small	Moderate
<b>NGO</b>			
N-1	World Vision Organization	Big	Near

Institutions Linkage Map of Melum commune (Group-5)

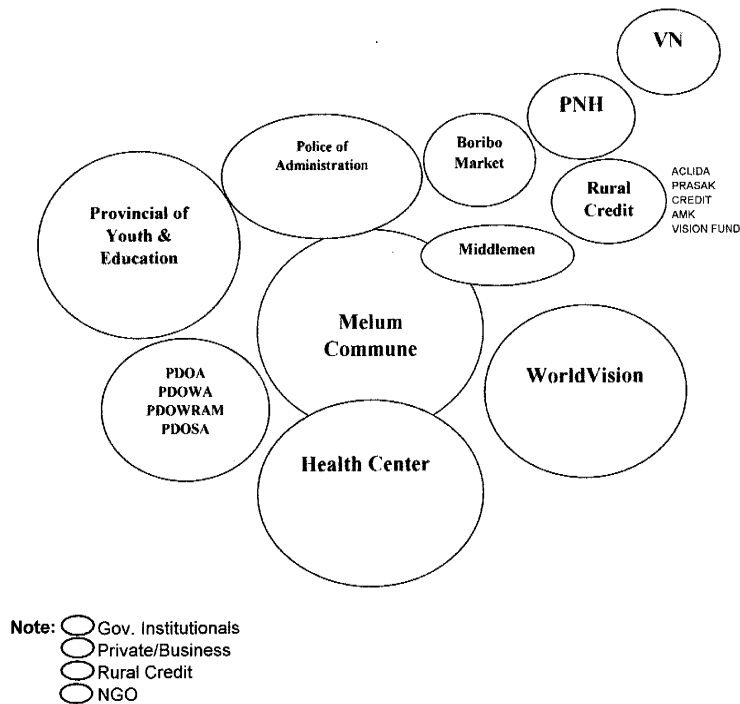


Figure 5.1.3 Institutional Linkage Map of Melum Commune

List of Institutions, its influence and physical distances, refer following Table of Melum Commune (Group-5)

Gov.	Institutional	Influence	Physical distances	Characteristics and transaction
		Large, moderate or small	Near, moderate or far	
G-1	Health Center	Big	Near	Provide medicine + Hospitalized
G-2	Provincial of Youth and Education	Big	Moderate	Provide vocational training general education
G-3	PDOWRAM	Fair	Moderate	Provide pumping machine and gasoline
G-4	Provincial Social Affair	Fair	Moderate	-Dam and Canal repairing
G-5	Provincial of Women Affair	Fair	Moderate	Establish community
G-6	Provincial of Agriculture	Fair	Moderate	Agriculture extension Bird flu extension
G-7	Police of Administration	Fair	Near	To Secure
G-8	Commune of Veterinary	Small	Near	Provide pesticide
G-7	Forestry Administration (Section)	Fair	Moderate	Agricultural production trade
<b>Private</b>				
P-1	Boribo Market	Fair	Moderate	Sell vegetables 5000R/day Sell fish 7500R/day Sell fruit 6000R/day Sell fishing gear 12.000R-20.000R/day
P-2	PHN Market			Buy Materials
P-3	VN Market			Sell Rices
P-4	Middlemen	Fair	Near	Buy Rice 700-800R/kg Pig 8000-9000R/kg Chicken 13.000R/kg
<b>Credit</b>				
C-1	ACLIDA	Small	Moderate	Borrowing and Lending Mortgage's rice-field Rate 2-3% per month Borrower had fidelity Have an agreement Eye witness & Authorized by local authority
C-2	CREDIT	Small	Moderate	
C-3	PRASAC	Small	Moderate	
C-4	AMK	Small	Moderate	
C-5	VISION FUND	Small	Moderate	
<b>NGO</b>				
N-1	World Vision Organization	Big	Near	Repair canal, Water gate, School

Flow Chart on Production Market Process of Melum Commune (Group-5)

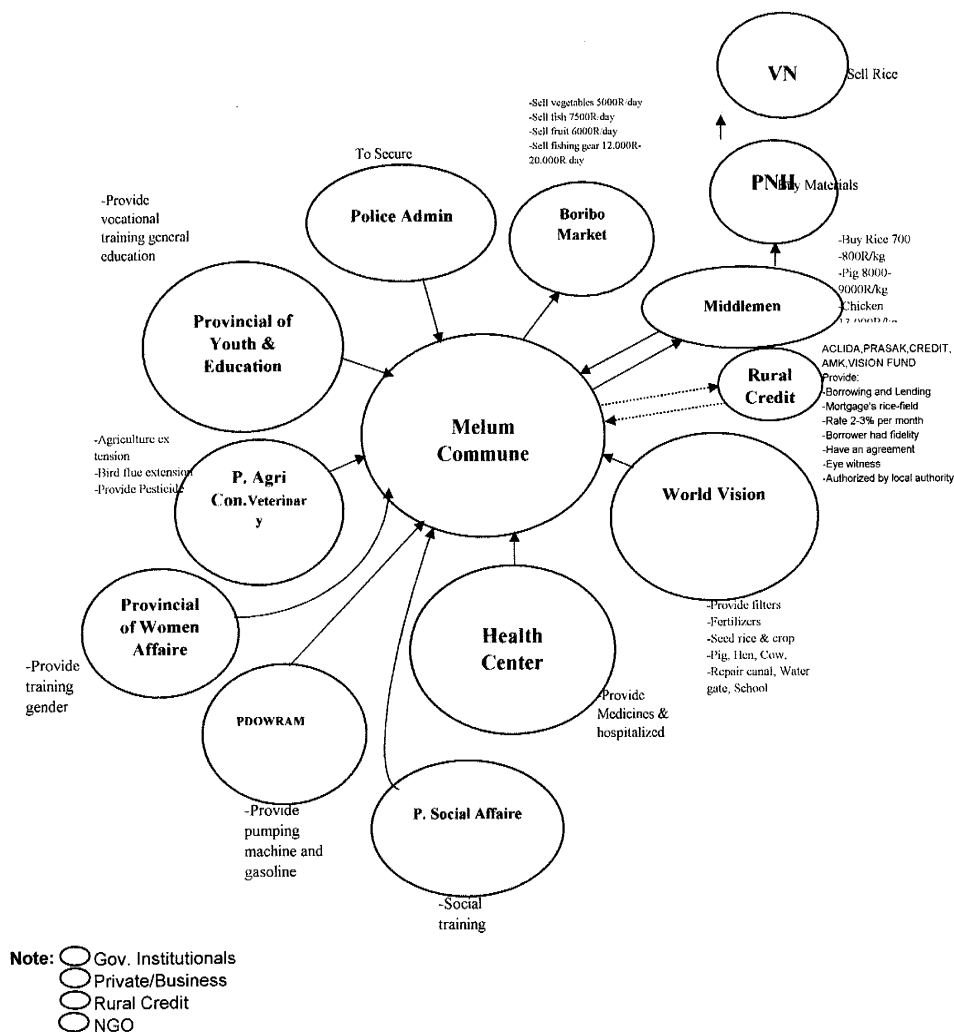


Figure 5.1.4 Production-Marketing Flow Process of Melum Commune

List of Institutions, its influence and physical distances, refer following.

Table of Pro-Sneth Commune (Group-4)

Gov.	Institutional	Influence	Physical distances
		Large, moderate or small	Near, moderate or far
G-1	Provincial of Agriculture and Forestry administration	Big	Moderate
G-2	MOWRAM	Fair	Moderate
G-3	Women community	Fair	Moderate
G-3	Health Center	Fair	Moderate
<b>Private</b>			
P-1	PONG RO Market	Small	Moderate
P-2	Middlemen	Small	Near
<b>Credit</b>			
C-1	ACLIDA	Fair	Moderate
C-2	CREDIT	Fair	Moderate
C-3	PRASAC	Fair	Moderate
C-4	KONGREY	Fair	Moderate
<b>NGO</b>			
N-1	Concern Organization	Big	Near
N-2	HEAK Organization	Big	Near
N-3	LMDS	Fair	Near
N-4	CDAK	Fair	Moderate
N-5	SREO	Small	Far
N-6	CC	Fair	Moderate

Institutions Linkage Map of Pro-Sneth commune (Group-4)

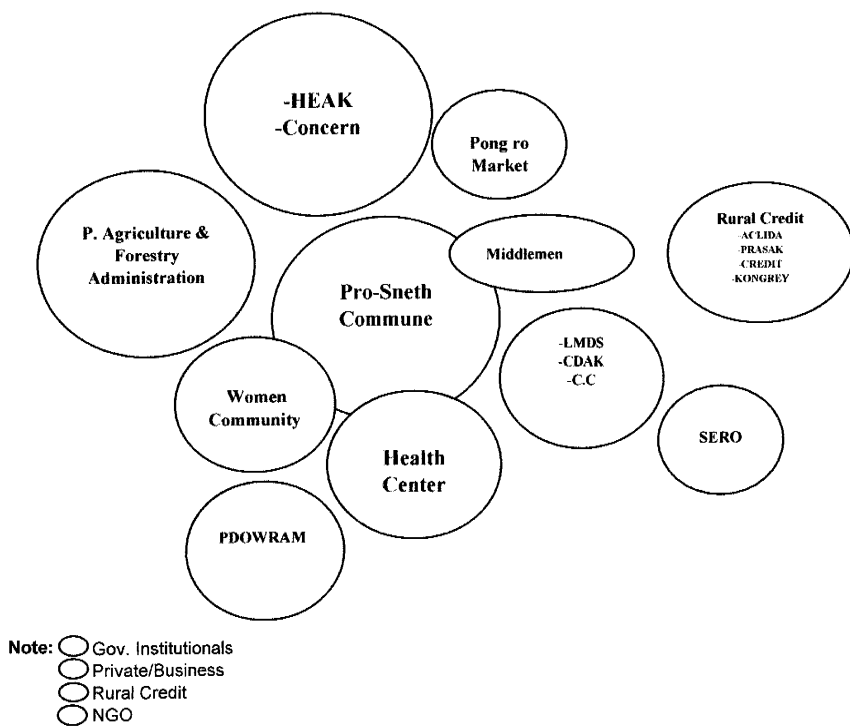


Figure 5.1.5 Institutional Linkage Map of Pro-Sneth Commune

Flow Chart on Production Market Process of Pro-Sneth Commune (Group-4)

Gov.	Institutional	Influence	Physical distances	Characteristics and transaction
		Large, moderate or small	Near, moderate or far	
G-1	Provincial of Agriculture and Forestry administration	Big	Moderate	Provide Rice seed, fertilizers, technical, cultivate, vegetables Take care animals disease
G-2	MOWRAM	Fair	Moderate	Drain off dam, canal, Water gate Training for FWUC
G-3	Women community	Fair	Moderate	No violations To prevent sex exploitations
G-3	Health Center	Fair	Moderate	Provide Medicines and hospitalized
<b>Private</b>				
P-1	PONG RO Market	Small	Moderate	Sell chicken 15.000R/kg Pock 16.000R/kg Rice 820R/kg Vegetables Buy equipments
P-2	Middlemen	Small	Near	Buy fishes, Beverages
<b>Credit</b>				
C-1	ACLIDA	Fair	Moderate	Borrowing and Lending Mortgage's rice-field
C-2	CREDIT	Fair	Moderate	Rate 2-3% per month Borrower had fidelity
C-3	PRASAC	Fair	Moderate	Have an agreement Eye witness &
C-4	KONGREY	Fair	Moderate	Authorized by local authority
<b>NGO</b>				
N-1	Concern Organization	Big	Near	Provide rice to dig canal & dam provide capital without rate for poverty people, Provide rice credit 20% of productivity, Provide Breed of pigs, hens, cows
N-2	HEAK Organization	Big	Near	Provide latrines, wells Breed of buffalos & goats, Bicycles, Rice Bank 20%/season Borrowing rate 3%/month, mortgage
N-3	LMDS	Fair	Near	Provide breed of pig & hen, Provide money lend To handicap without Rate
N-4	CDAK	Fair	Moderate	Provide technology of agriculture depend on Natural Principal
N-5	CC	Fair	Moderate	Provide filters, wells, giants jars support nutrition for children
N-6	SREO	Small	Far	

Flow Chart on Production Market Process of Pro-Sneth Commune (Group-4)

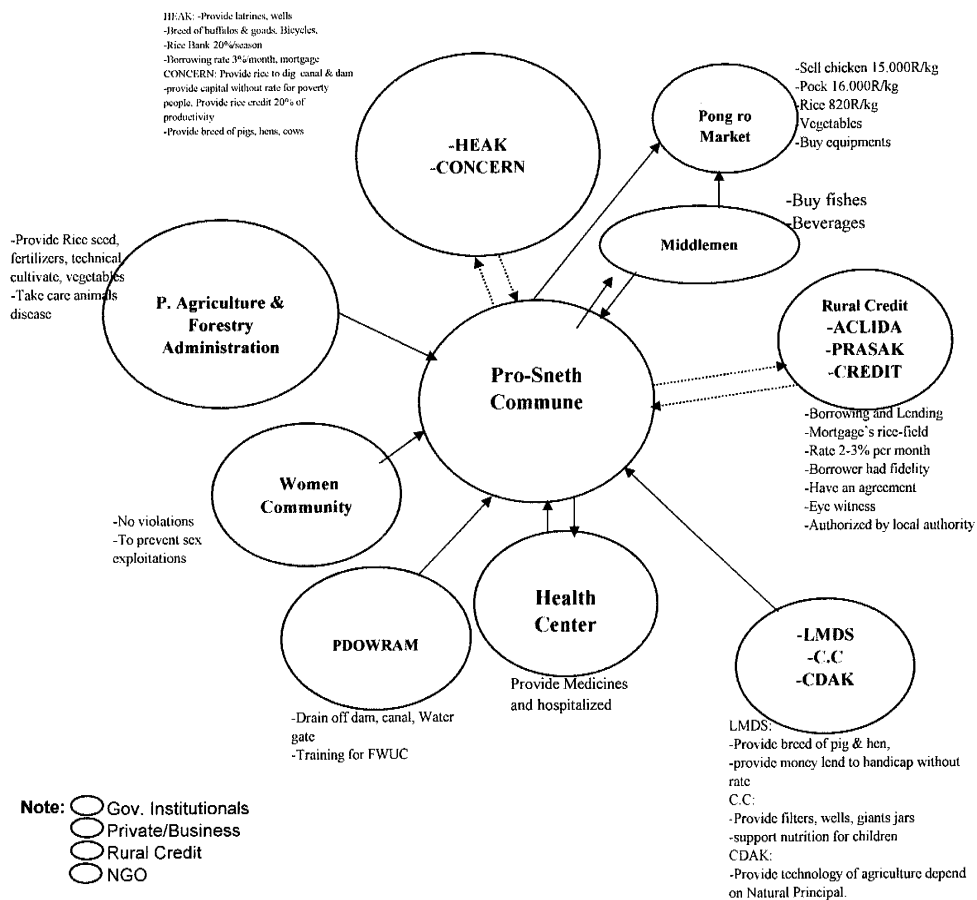


Figure 5.16 Production-Marketing Flow Process of Pro-Sneth Commune

List of Institutions, its influence and physical distances, refer following  
 Table of Pich Changva and Chak Communes (Group-8 or Group-9)

Gov.	Institutional	Influence	Physical distances
		Large, moderate or small	Near, moderate or far
G-1	Provincial of Agriculture	Big	Far
G-2	PDOWRAM	Big	Moderate
G-3	Provincial of Women Affair	Big	Moderate
G-4	Provincial of Health	Big	Moderate
G-5	Provincial of Environment	Big	Moderate
G-6	Forestry Administration	Big	Moderate
G-7	Police Administration	Big	Near
G-8	Provincial of land management	Big	Far
G-9	Provincial of Education youth and sport	Big	Moderate
<b>Private</b>			
P-1	Middlemen	Big	Near
P-2	Pon lery Market	Big	Moderate
P-3	Boribo	Big	Moderate
<b>Credit</b>			
C-1	ACLIDA	Small	Moderate
C-2	AEC	Fair	Moderate
C-3	PRASAC	Small	Moderate
C-4	HATHA	Fair	Moderate
<b>NGO</b>			
N-1	World Vision Organization	Big	Moderate
N-2	Monus Lok Thmey Organization	Big	Moderate
N-3	CDAK	Small	Moderate

Institutions Linkage Map of Pich Changva and Chak communes (Group-8 or Group-9)

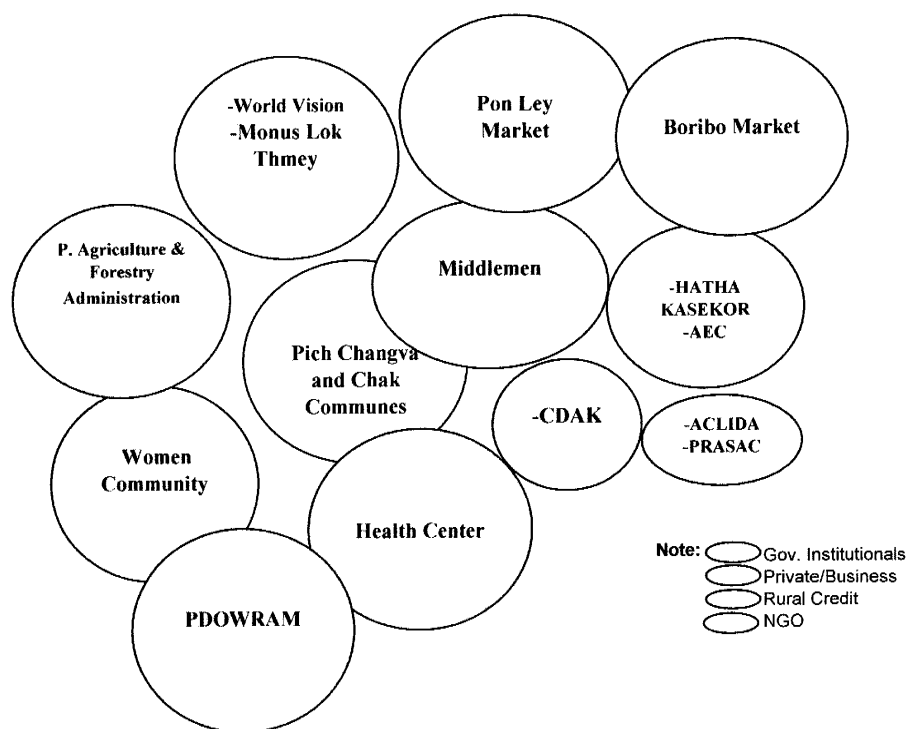


Figure 5.1.7 Institutional Linkage Map of Pich Changva and Chak Commune



Flow Chart on Production Market Process of Pich Changva and Chak Communes (Group-8 or Group-9)

Gov.	Institutional	Influence	Physical distances	Characteristics and transaction
		Large, moderate or small	Near, moderate or far	
G-1	Provincial of Agriculture	Big	Moderate	Provide technical of agriculture
G-2	PDOWRAM	Big	Moderate	Drain off dam, canal & water gate
G-3	Provincial of Women Affair	Big	Moderate	No violations To prevent sex exploitations, gender touching
G-4	Provincial of Health	Big	Moderate	provide nets, health care training, medicine & build health center
G-5	Provincial of Environment	Big	Moderate	provide training not to polluted environment
G-6	Forestry Administration	Big	Moderate	to prevent cut off the forest
G-7	Police Administration	Big	Near	None
G-8	Provincial of land management	Big	Far	to touching law of land
G-9	Provincial of Education youth and sport	Big	Moderate	Training and primary education, building school
<b>Private</b>				
P-1	Middlemen	Big	Near	Buy rice, chicken, pig, duck, vegetables
P-2	Pon ley Market	Big	Moderate	Buy construction materials, fodder, sell unhusked rice + huseked rice
P-3	Boribo	Big	Moderate	Buy construction materials, fodder, sell unhusked rice + huseked rice
<b>Credit</b>				
C-1	ACLIDA	Small	Moderate	
C-2	AEC	Fair	Moderate	Borrowing and Lending Mortgage's rice-field Rate
C-3	PRASAC	Small	Moderate	2-3% per month Borrower had fidelity Have an agreement Eye witness Authorized by local authority To buy threshing, fertilizer, fodder
C-4	HATHA	Fair	Moderate	
<b>NGO</b>				
N-1	World Vision Organization	Big	Moderate	Provide: buffalo, training how to make campost, provide path, latrine, well, salary
N-2	New humanity Organization	Big	Moderate	
N-4	CDAK	Small	Moderate	

Flow Chart on Production Market Process of Pich Changva and Chak Communes (Group-8 or Group-9)

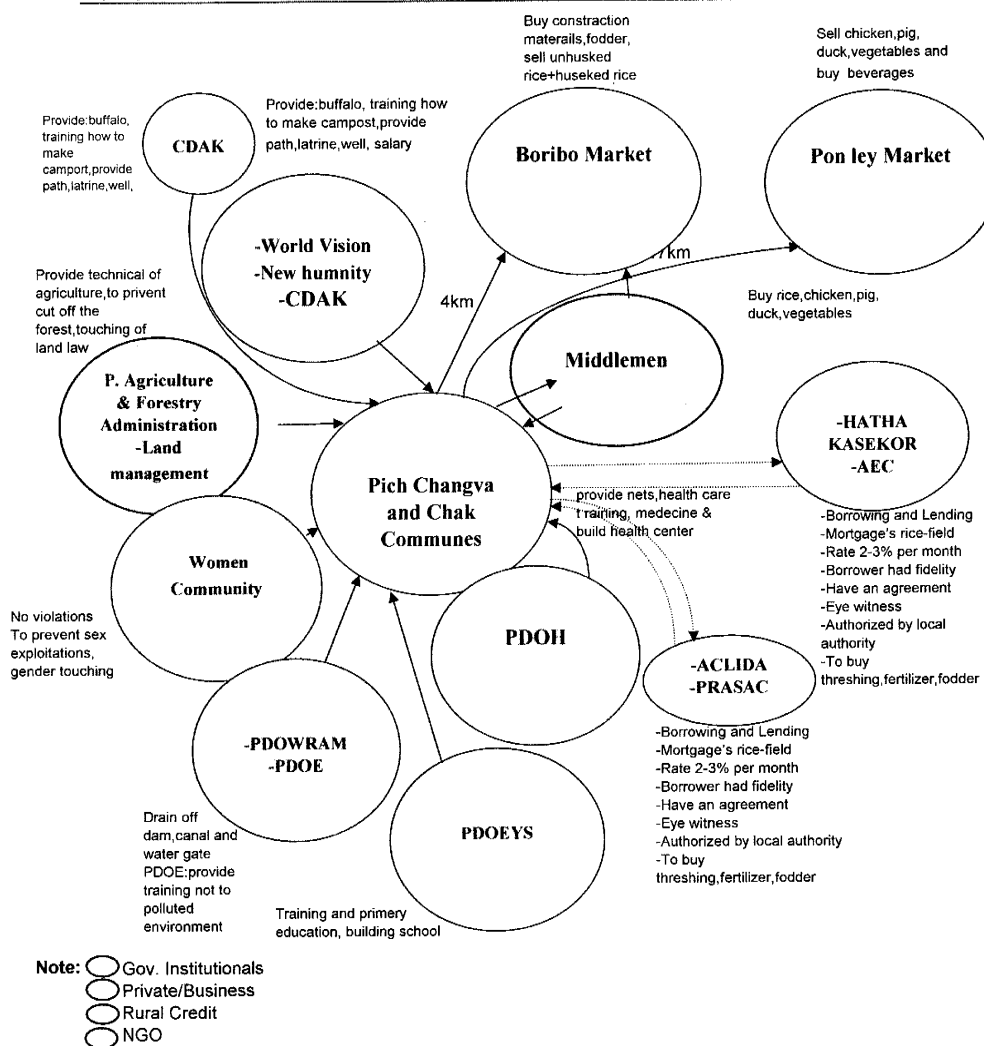


Figure 5.1.8 Production-Marketing Flow Process of Pich Changva and Chak Commune

List of Institutions, its influence and physical distances,  
refer following Table of Phsar Commune (Group-6)

Gov.	Institutional	Influence	Physical distances
		Large, moderate or small	Near, moderate or far
G-1	Provincial of Agriculture	Big	Moderate
G-2	PDOWRAM	Big	Moderate
	Commune of veterinary	Big	Near
G-4	Provincial of Education youth and sport	Big	Moderate
G-5	Health Center	Small	Moderate
G-6	Provincial of Environment	Big	Moderate
G-7	Police Administration	Fair	Near
<b>Private</b>			
P-1	Middlemen	Big	Near
P-3	BoriboMarket	Big	Moderate
<b>Credit</b>			
C-1	ACLIDA	Small	Moderate
C-2	AMK	Fair	Moderate
C-3	PRASAC	Small	Moderate
C-4	CREDIT	Fair	Moderate
<b>NGO</b>			
N-1	Group of saving	Small	Near

Institutions Linkage Map of Phsar commune (Group-6)

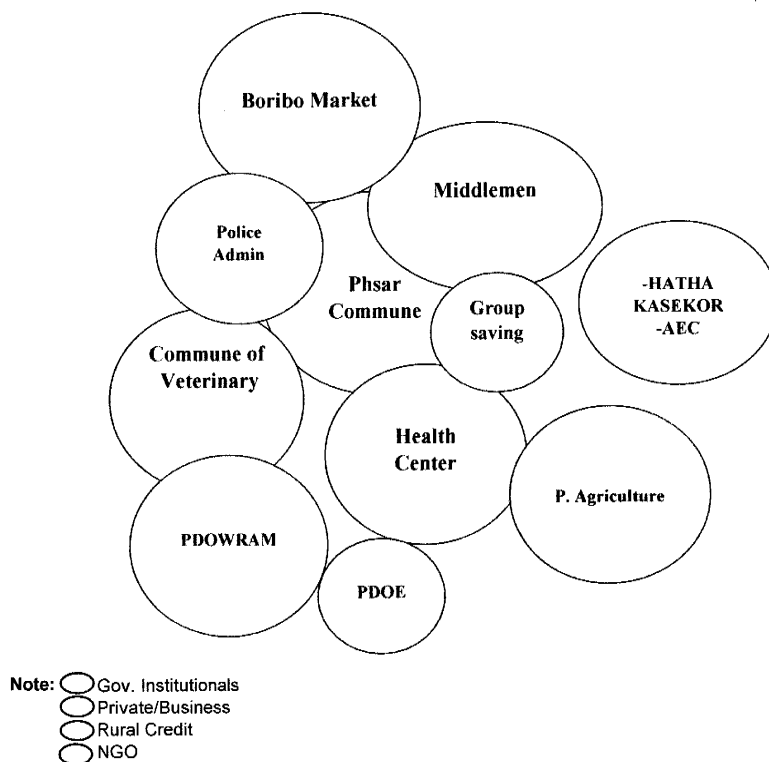


Figure 5.1.9 Institutional Linkage Map of Phsar Commune

Flow Chart on Production Market Process of Phsar Commune (Group-6)

Gov.	Institutional	Influence	Physical distances	Characteristics and transaction
		Large, moderate or small	Near, moderate or far	
G-1	Provincial of Agriculture	Big	Moderate	Provide technical agriculture, fertilizers
G-2	PDOWRAM	Big	Moderate	Provide pumping machine & oil
G-3	Commune of veterinary	Big	Near	Take care for animals & training on birth flue
G-4	Provincial of Education youth and sport	Big	Moderate	None
G-5	Health Center	Small	Moderate	Provide small medicines
G-6	Provincial of Environment	Small	Far	Seldom to contact
G-7	Police Administration	Fair	Near	None
<b>Private</b>				
P-1	Middlemen	Big	Near	Buy rice 800R/kg, chicken 13.000R/kg, pig 9.200R/kg
P-2	Boribo Market	Big	Moderate	Buy fertilizers and food, sell agriculture productions
P-3	K.Chhang Market	Small	Moderate	Sell, chicken and pig get profit 3%
<b>Credit</b>				
C-1	ACLIDA	Small	Moderate	Borrowing and Lending Mortgage's rice-field Rate 2-3% per month Borrower had
C-2	AMK	Fair	Moderate	
C-3	PRASAC	Small	Moderate	
C-4	CREDIT	Fair	Moderate	
<b>NGO</b>				
N-1	Group of saving	Small	Near	Saving money to buy cow, rice to support in community

Flow Chart on Production Market Process of Phsar Commune (Group-6)

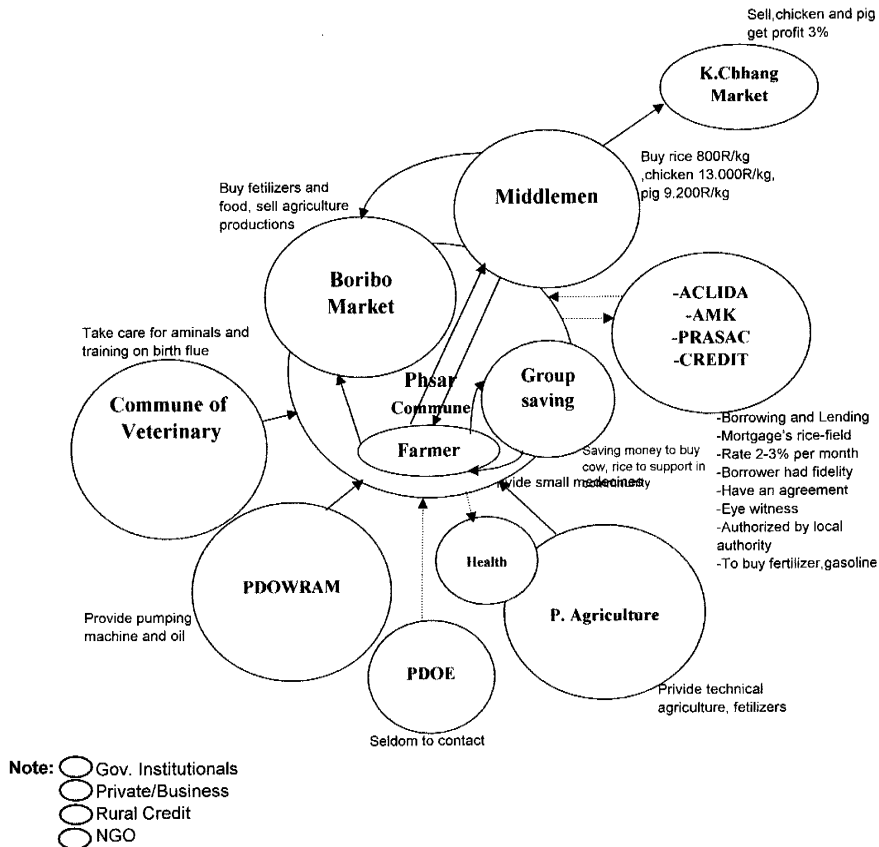


Figure 5.1.10 Production-Marketing Flow Process of Phsar Commune

List of Institutions, its influence and physical distances, refer following Table of Anh Chanh Ruong Commune (Group-1)

Gov.	Institutional	Influence	Physical distances
		Large, moderate or small	Near, moderate or far
G-1	Provincial of Agriculture	Big	Moderate
G-2	PDOWRAM	Big	Moderate
G-3	Red Cross	Small	Near
<b>Private</b>			
P-1	Middlemen	Big	Near
P-2	Boribo Market	Big	Near
P-3	Pon Ley Market	Big	Moderate
<b>Credit</b>			
C-1	ACLIDA	Small	Moderate
C-2	AMK	Small	Moderate
C-3	Vision Fund	Small	Moderate
C-4	CREDIT	Small	Moderate
C-5	Hatha Kasekor	Fair	Moderate
<b>NGO</b>			
N-1	Kamphuchea truse	Small	Moderate
N-2	PC	Small	Moderate
N-3	NH	Big	Moderate
N-4	CDAK	Small	Moderate
N-5	AEC	Fair	Moderate

Institutions Linkage Map of Anh Chanh Ruong commune (Group-1)

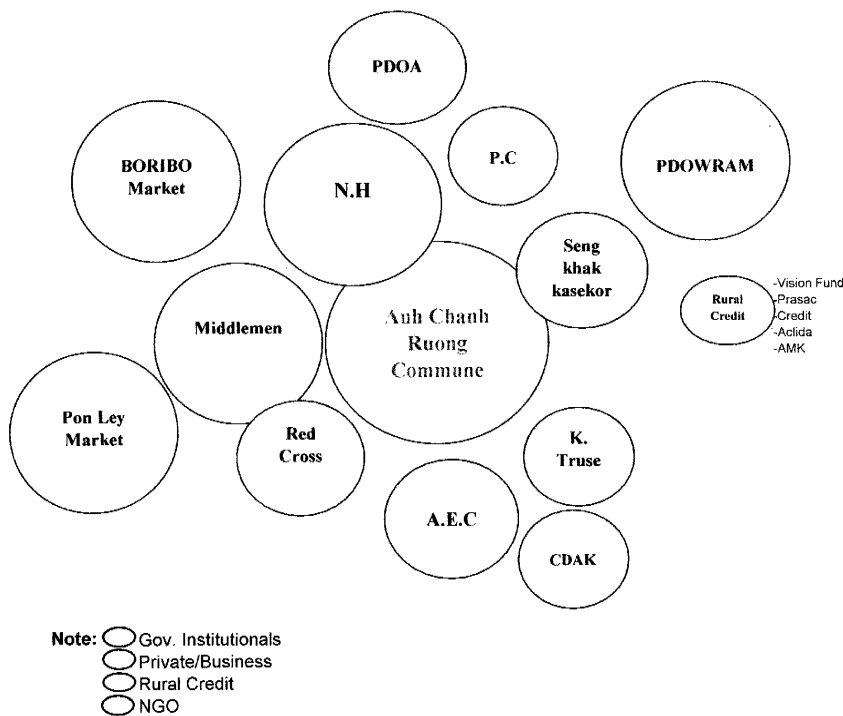


Figure 5.1.11 Institutional Linkage Map of Anh Chanh Ruong Commune

Flow Chart on Production Market Process of Anh Chanh Ruong Commune (Group-1)

Gov.	Institutional	Influence	Physical distances	Characteristics and transaction
		Large, moderate or small	Near, moderate or far	
G-1	Provincial of Agriculture	Fair	Moderate	Improved for agriculture technology and provide seeds, crops
G-2	PDOWRAM	Big	Moderate	Study master plan for irrigation, dam, canal, and provide pumping machine
G-3	Red Cross	Small	Near	Support for flood, poverty people
<b>Private</b>				
P-1	Middlemen	Big	Near	Buy chicken 12.000R/kg, pig 8.000R/kg, cow& buffalo 16.000R/kg, rice 800R/kg
P-2	Boribo Market	Big	Near	Agriculture production trade
P-3	Pon Ley Market	Big	Moderate	Sell chicken 12.000R/kg, pig 8.000R/kg, cow& buffalo 16.000R/kg, rice 800R/kg
<b>Credit</b>				
C-1	Sangha kasekor	Small	Moderate	Money Lender, Mortgage's rice-field Rate 2-3% per month, Borrower had fidelity, Have an agreement, Eye witness, Authorized by local authority, To buy fertilizer
C-2	AEC	Fair	Moderate	
C-3	ACLIDA	Small	Moderate	Vision Fund, Prasac, Credit, Acida, AMK, Borrowing Money, Mortgage's rice-field Rate 3% per month, Borrower had fidelity, Have an agreement, Eye witness, Authorized by local authority, To buy fertilizer
C-4	AMK	Small	Moderate	
C-5	Vision Fund	Small	Moderate	
C-6	CREDIT	Small	Moderate	
<b>NGO</b>				
N-1	Kamphuchea trust	Fair	Moderate	K.trust, support land mine victims, CDAK, Provide training on agriculture and using compost
N-2	CDAK	Small	Moderate	
N-3	NH	Big	Moderate	Provide buffalo, training how to make compost, provide path, latrine, well, salary
N-4	Pact Cambodia	Small	Moderate	Training on labor law & principle cord

Flow Chart on Production Market Process of Anh Chanh Ruong Commune (Group-1)

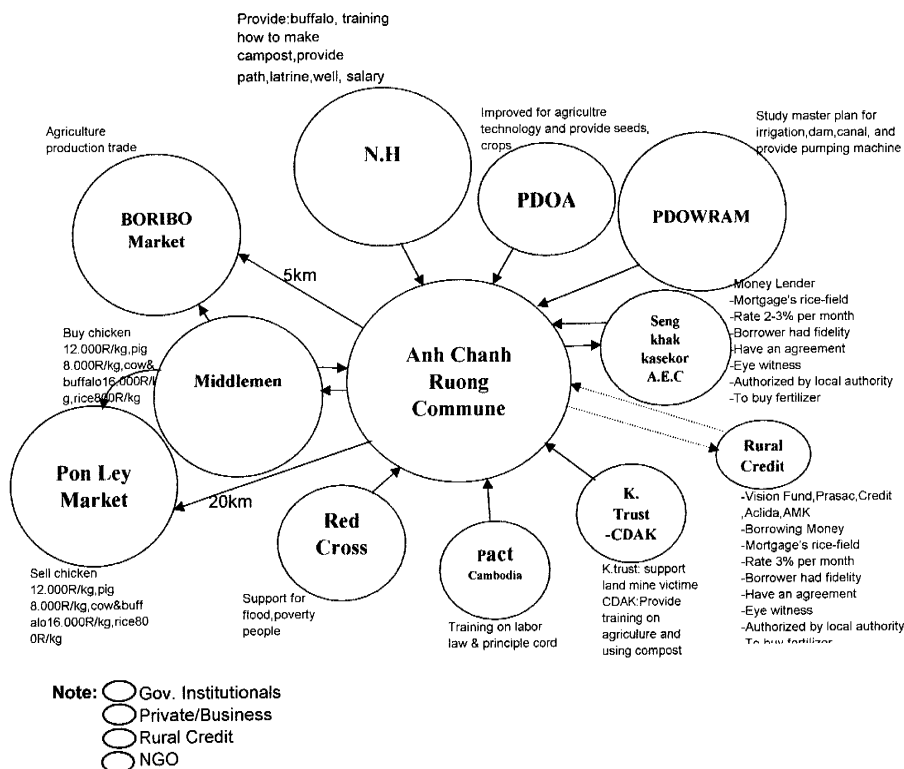


Figure 5.1.12 Production-Marketing Flow Process of Anh Chanh Ruong Commune

List of Institutions, its influence and physical distances, refer following Table of Khaon Rong and Popel Communes (Group-7 or Group-2)

Gov.	Institutional	Influence		Physical distances	
		Large, moderate or small	Near, moderate or far	Near, moderate or far	Near, moderate or far
G-1	PDOWRAM	Big	Moderate	Moderate	
G-2	Provincial of Women Affaire	Fair	Moderate	Moderate	
G-3	Provincial of Environment	Fair	Moderate	Moderate	
G-4	Provincial of Health	Small	Moderate	Moderate	
G-4	District of land management	Fair	Near	Near	
G-5	Commune Administration	Fair	Near	Near	
G-5	Fishery Administration (Sector)	Small	Near	Near	
<b>Private</b>					
P-1	Middlemen	Small	Near	Near	
P-2	Pon Ley Market	Big	Near	Near	
<b>Credit</b>					
C-1	ACLIDA	Fair	Moderate	Moderate	
C-2	Prasac	Fair	Moderate	Moderate	
<b>NGO</b>					
N-1	World Vision	Big	Moderate	Moderate	
N-2	CDAK	Small	Moderate	Moderate	
N-3	NH	Small	Moderate	Moderate	

Institutions Linkage Map of Khaon Rong and Popel communes (Group-7 or Group-2)

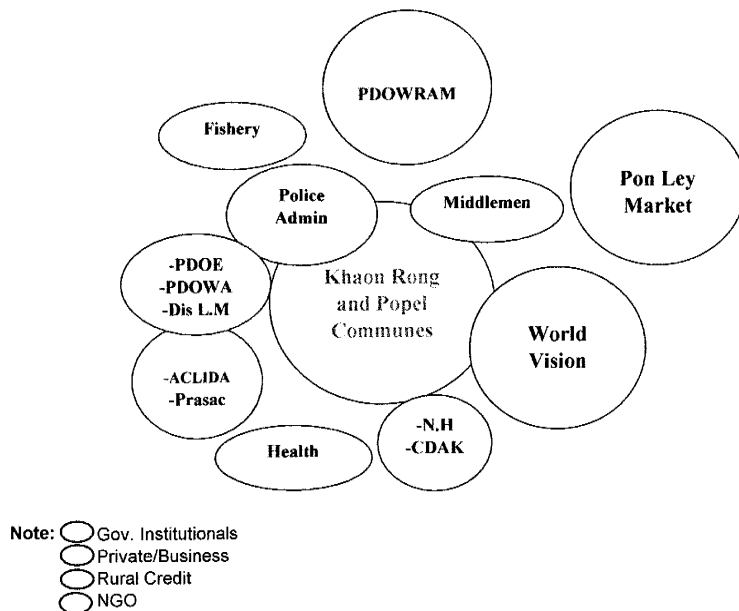


Figure 5.1.13 Institutional Linkage Map of Khaon Rong and Popel Commune

Flow Chart on Production Market Process of Khaon Rong and Popel Communes (Group-7 or Group-2)

Gov.	Institutional	Influence	Physical distances	Characteristics
		Large, moderate or small	Near, moderate or far	and transaction
G-1	PDOWRAM	Big	Moderate	Study master plan for irrigation,dam,canal, and provide pumping machine
G-2	Provincial of Women Affaire	Fair	Moderate	Vocaational training and public environment
G-3	Provincial of Environment	Fair	Moderate	
G-4	Provincial of Health	Small	Moderate	Provide medicine to health care center and improved of public health
G-4	District of land management	Fair	Near	Vocaational training and public environment
G-5	Commune Administration	Fair	Near	To make secure & to have good manners
G-5	Fishery Administration (Sector)	Small	Near	To privent illegal fishery
<b>Private</b>				
P-1	Middlemen	Small	Near	Buy rice, carpenters tables, chair, windows,bed
P-2	Pon Ley Market	Big	Near	Agriculture production trade, buy materials
<b>Credit</b>				
C-1	ACLIDA	Fair	Moderate	Borrowing,MoneyMortgage's rice-field Rate 3% per month Borrowerhad fidelityHave an agreement Eyewitness Authorized by local authority To buy fertilizer
C-2	Prasac	Fair	Moderate	
<b>NGO</b>				
N-1	World Vision	Big	Moderate	Drain off dam,canal,water gate, path, provide school, latrine, well, fertilizer warehouse,provide rice seeds,crops,cow,pig&hens
N-2	CDAK	Small	Moderate	
N-3	NH	Small	Moderate	

Flow Chart on Production Market Process of Khaon Rong and Popel Communes (Group-7 or Group-2)

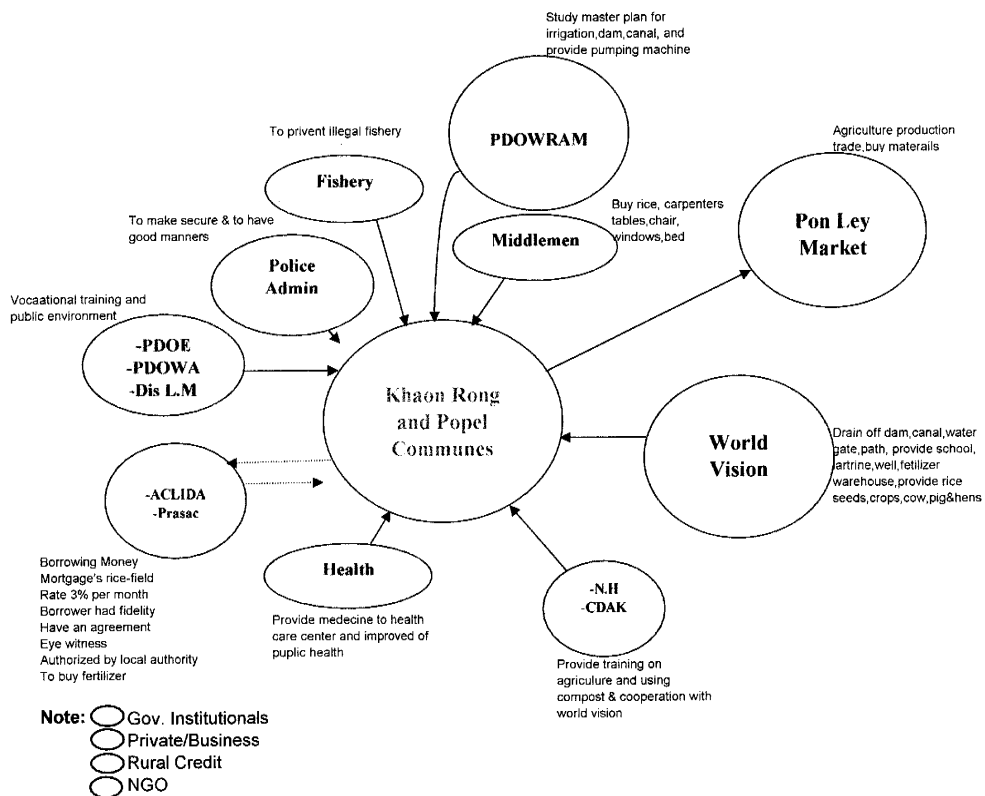


Figure 5.1.14 Production-Marketing Flow Process of Khaon Rong and Popel Commune