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Department of Planning

## Northern Rural Infrastructure Development Sector Project



### Feasibility Study on Houay Sat Irrigation Subproject in Paktha District of Bokeo province

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Nippon Koei Co., Ltd.  
in association with  
NIACONSULT, Inc. & Lao Consulting Group

**Northern Rural Infrastructure Development Sector Project**

**Feasibility Study on  
Houay Sat Irrigation Subproject**

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Location Map of Houay Sat Irrigation Subproject

### **List of Abbreviation**

ADB	:	Asian Development Bank
DAFO	:	District Agriculture and Forestry Office
DCO	:	District Coordination Office
DLWU	:	District Lao Women's Union
DMU	:	District Management Unit
DOI	:	Department of Irrigation
DOP	:	Department of Planning
EA	:	Executing Agency
EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
EMP	:	Environmental Management Plan
FS	:	Feasibility Study
GAP	:	Gender Action Plan
GIC	:	Grant Implementation Consultant
GOL	:	Government of Lao PDR
HH	:	Household
HYV	:	High Yielding Variety
IA	:	Implementing Agency
IEE	:	Initial Environmental Examination
IPP	:	Indigenous Peoples Plan
ISA	:	Initial Social Assessment
ISF	:	Irrigation Service Fee
Lao PDR	:	Lao People's Democratic Republic
MAF	:	Ministry of Agriculture and Forestry
NAFRI	:	National Agriculture and Forestry Research Institute
NAFES	:	National Agriculture and Forestry Extension Service
NCMI	:	Northern Community-Managed Irrigation Sector Project
NRI	:	Northern Rural Infrastructure Development Sector Project
NSC	:	National Steering Committee
NPM	:	National Project Manager
NPMO	:	National Project Management Office
O&M	:	Operation and Maintenance
PAM	:	Project Administration Manual
PAFO	:	Provincial Agriculture Forestry Office
PBME	:	Project Benefit Monitoring and Evaluation
PLUP	:	Participatory Land Use Planning
PPO	:	Provincial Project Office
PPTA	:	Project Preparatory Technical Assistance
RMC	:	Road Maintenance Committee
SIR	:	Subproject Investment Report
SRI	:	System of Rice Intensification
TA	:	Technical Assistance
TOR	:	Terms of Reference
WUA	:	Water User Association
WUG	:	Water User Group

**UNITS**

ha	:	Hectare
kg	:	Kilogram
km	:	Kilometer
l	:	Liter
m	:	Meter
m <sup>2</sup>	:	Square meter
m <sup>3</sup>	:	Cubic meter
mm	:	Millimeter

**Northern Rural Infrastructure Development Sector Project**  
**Feasibility Study on**  
**Houay Sat Irrigation Rehabilitation Subproject**

**1. SUBPROJECT SUMMARY**

1. The Northern Rural Infrastructure Sector Project (NRI) main aim is to provide the rural community with access to and participation in the market economy. This is to be realized through the increase in incremental production in saleable commodities and promotion of agricultural productivity.

2. NRI has four main outputs: (i) production and productivity enhancing rural infrastructure constructed and/or rehabilitated; (ii) productivity and impact enhancing initiatives adopted; (iii) capacities of national, provincial and district agencies strengthened to enable a sector development approach; and (iv) efficient and effective delivery of subprojects and Project management.

3. This Feasibility Study for the Houay Sat Irrigation Rehabilitation Subproject focuses on Outputs 1 and 2 as detailed below.

**1.1 Subproject Description**

4. The Subproject is located in the District of Paktha, Bokeo Province. The subproject will benefit Haad Don Keo village. It is located on the western bank of the Mekong River. From Paktha District Center, it can be reached through a 27.5 km land drive or 35 to 40 minutes speed boat ride along the Mekong River. Houay Sat is the stream that provides the main water source for the irrigation. The Sat discharges into the Mekong.

5. Houay Sat has 6 existing weirs/regulating structures across it: 1) Pakhouaykhan; 2) Fai Houanar; 3) Fai Phouvat; 4) Pakhouay ngat; 5) Napoung; and 6) Hangnar. The weirs/regulating structures are owned and managed by villagers of Haad Don Keo. The structure at Phouvat is a concrete weir constructed in 2009 by the government with contribution in labor from the villagers. All the other 5 structures are indigenous wooden cross regulating structures constructed and maintained by the water users. Existing main canals are unlined earth canals totaling 4.29 km.

6. The village of Haad Don Keo is located on the banks of the Mekong. There is an existing track from the village to Phouvat weir totaling 5 km.

7. The existing irrigation system irrigates some 59 ha in the wet season and 20 ha in the dry with a rainfed area of 27 ha.

**(1) Output 1: Production and productivity enhancing rural infrastructure**

8. The proposed subproject involves improvement of the existing Phouvat concrete weir and construction of a new concrete weir to replace the indigenous wooden weir at Napoung site, extension of canals and lining of some sections, installation of canal structures. The proposed subproject also includes rehabilitation of the irrigation system intake, sluice gate, canal turnout gates, etc. at Phouvat weir.

9. The two weirs upstream of Phouvat weir will not be affected by the NRI subproject interventions. The areas currently serviced by number 3 up to the number 6 weir will benefit

from the proposed subproject. Hence, there are no potential conflicts on water use among the water users of Houay Sat.

10. The proposed infrastructure works will contribute to the expansion of the irrigated area from the existing 86 ha to 120 ha.

## **(2) Output 2: Productivity and Impact Enhancing Initiatives**

11. These initiatives will comprise of compulsory and optional initiatives. The compulsory initiatives will include (i) support for WUGs established to operate and maintain the rehabilitated facilities; and (ii) water catchment identification and zoning. Optional initiatives will need to be further discussed with the beneficiaries during detailed design stage and could be selected from production, post harvest handling, processing and the development of market linkage initiatives.

### **1.2 Socio-economic Conditions**

12. The social environment of the proposed subproject is supportive to the implementation of the Subproject.

13. The village authorities and households in the area have no negative responses or opposition to the proposed subproject. They expressed agreement and support to the implementation of the subproject during stakeholders' consultations and during the data collection for the Social Impact Assessment.

14. The subproject is expected to improve water availability for two seasons and will improve rice production during the wet and dry season and offer the potential of producing other marketable crops during the dry season.

15. The proposed subproject involves improvement of existing irrigation systems and is expected to have no impact on crops and structures. Affected lands, if any, will be determined during the detailed design phase and will be subjected to consultation and negotiation with the affected households (AH) to agree on the form of compensation or mitigation measures before subproject implementation.

16. An informal Water Users' Groups WUG exist in the area with 59 HHs as members. The establishment of a Water Users' Association (WUA) will start from this existing WUG.

17. The 152 HHs in Ban Hat Don Keo are all of the Lao-Tai Ethno-Linguistic Group and hence, no cultural or ethnic differences among the subproject beneficiaries.

18. There are 6 existing weirs in the Houay Sat, which area all owned by villagers of Ban Haad Don Keo. The proposed subproject can be easily implemented with participation and consultation with the villagers. Potential conflicts on water use can be resolved through a Water Users' Association (WUA) that will be established and strengthened through the NRI.

19. Literacy as reported in the Village Household Masterlist is at 68% of the population. This is a concern that must be considered in the conduct of meetings, consultations and trainings for the stakeholders.

20. Households in Haad Don Keo village are generally rice sufficient. About 95% of HHs in the village is either having rice surplus (30%) or rice sufficient (65%). Only about 5% or 8 HHs are having rice deficit of less than 1 month to more than 4 months.

21. Village authorities reported that the main occupation of HHs in Haad Don Keo is



agriculture crop production. This is validated by the Interview of Sample HHs. The main source of income of HHs in the village is agriculture, mainly rice production. Based on the results of Sample HH interview, 90% of HHs are involved in agriculture production and 80% are involved in non-agriculture sources of income.

22. Agriculture income comes mainly from rice production, production of other crops and livestock/poultry/fish production. Non-agriculture income sources of village households are farm labor, small business, labor outside farms/village, handicraft, sales of non-timber forest products (NFTP) and vi) other various sources.

23. The average HH income is composed of 92% from agriculture sources and 8% from non-agriculture sources. The average monthly per capita income is quite high at 1.09 million kips/capita/month, however, it must be noted that 20% of the sample household is classified as low income or poor. Based on the Village HHs Masterlist poor HHs in the area is in the range of 10%.

24. There are 6 landless households (LLHH). Two (2) of the LLHH are female-headed HHs (FHHs) and two are classified as poor HHs (not the 2 landless FHHs).

25. There are 15 FHHs in the village. Two (2) are having rice deficits and one (1) is categorized as poor.

26. The poor HHs, LLHHs and FHHs should be prioritized in the hiring of labor for the subproject construction and in the delivery of subproject assistance of associated initiatives.

27. The leadership of the Village Administration as well as in Village Organizations are dominated by men, although membership is open to both men and women. Promotion of women representation in the leadership of organizations, the WUG, in the case of this subproject is a concern to be deal with.

28. Women primarily performs household responsibilities and are performing alongside with men responsibilities in agriculture production and in decision-making for the household.

29. The available labor within the communities at 312 people seems sufficient if community participation through labor contribution will be required.

30. Results of village consultation show that the main problem of HHs in the area is low income due to insufficient lands, low yield, insufficient irrigation water supply for crop production, limited market, low prices of agricultural products, insufficient knowledge/experience on improved agriculture technologies, and limited alternative sources of income. Recommended solutions to these problems include: i) rehabilitation of the existing irrigation system; ii) establishment and capability development of a WUA; iii) capability development of farmers on improved agriculture production technologies; iv) support and technical assistance on marketing; v) support and technical assistance on contract farming; and vi) programs on alternative sources of income for women and poor/landless households.

### **1.3 Subproject Cost**

31. The civil works is estimated to cost US\$366,520. The total cost of works to rehabilitate the system including indirect costs and associated initiatives is \$547,460 equivalent to US\$2,319/ha. Summary costs are presented in the Table below.

### Summary of costs for Houay Sat Subproject

Description	Amount (US\$ '000s)	% of Total
Civil Works	366.5	67
Survey/design and construction supervision	43.9	8
Associated initiatives	45.0	8
Indirect investment cost (vehicles & equipment, consulting services, & training/studies)	82.8	15
Physical contingency	9.1	2
<b>Total Investment Cost</b>	<b>547.3</b>	<b>100%</b>

#### 1.4 Implementation Arrangement

32. The executing agency for the subproject will be the provincial governor's office of Bokeo that will delegate responsibility for subproject implementation to its provincial agriculture and forestry office (PAFO). Bokeo's PAFO will, in turn, designate responsibility for day to day implementation and monitoring of the subproject to the provincial project office (PPO) established within its premises. If external consultants are required for survey and design of the scheme, recruitment of consultants to prepare the detailed subproject design and construction supervision will be managed by the National Project Management Office (NPMO). Works contracts will be procured by the NPMO based on provincially and NPMO certified and approved designs. PAFO, through its PPO, will be involved both in project management of the subproject but also in confirming the technical specifications of the rehabilitated weir and canals for the schemes. The associated investments will be delivered by established district agriculture and forestry offices under a performance based contract to the PPO under the supervision of the NPMO.

#### 1.5 Subproject Impact

33. The subproject location is very close to the Thai border which is the main market for the agricultural produce from the subproject area. As such it is expected that with the expected increase in agricultural production resulting of the subproject investments, the economic impact of the subproject will be substantial.

34. The Houay Sat Irrigation Rehabilitation Subproject is expected to be economically viable with the calculated economic internal rate of return of 13 percent. The economic returns of the subproject are somewhat at risk if there is an increase of 20 percent in investment cost or a 20 percent decrease in project benefits which will reduce the EIRR to 10 percent and nine percent respectively. Effective O&M, allowing for an acceptable life of the project, is a basic assumption for the profitability of this investment.

#### 1.6 Safeguard Considerations

35. The Initial Environmental Examination found that the subproject will not cause significant negative environmental impacts and no further special study or an environmental impact assessment is required. Potential negative impacts relate to the construction phase and can be managed and reduced to acceptable levels through the implementation of an Environmental Management Plan. No further environmental assessment is therefore required. The subproject is therefore be categorized as Category B according to the ADB's classification system - judged to have some adverse environmental impacts but of lesser degree or significance.

36. The system rehabilitation/improvement is expected not to require acquisition of lands for right-of-ways nor will impact on crops/trees and existing permanent structures. It is very unlikely that the irrigation improvement/rehabilitation works will result to: a) loss of land; b) loss of houses/structures; c) loss of crops and trees; d) loss of common property resources; e) cases of economic resettlement; and f) effects on vulnerable people. However, this should be carefully checked during the project survey and design phase. Mitigation measures must be planned for any effect that will be determined and should form part of the project Environmental Management Plan (EMP) and/or Resettlement Action Plan (RAP).

37. The people in Ban Hat Don Keo belong to one ethnic group - "Keun Ethnic Group" or Leu and classified to belong to the Lao-Tai Ethnic-Linguistic Group. Hence, an Indigenous People's Action Plan IPP is not required.

38. The Gender Action Plan for the Subproject recommends the involvement of women in all phases of subproject development must be promoted considering that they perform important roles in agriculture production and in decision-making responsibilities. The GAP specifies: i) 30% participation of women in the WUG/FPG; ii) at least 30% of women participants in trainings on marketing and financial/budget management; iii) at least 30% of women participation on all subproject management committees (marketing initiatives, production groups, etc.); iv) female focused extension services/livelihood programs designed for and delivered to women with at least 30% of extension training for women particularly the 15 FHHs/2 landless FHHs targeted for associated initiatives of the subproject; v) women assigned in financial related positions in the WUG and FPG; vi) implementing agencies will ensure land use certificates are updated in both spouses' names; vii) developing programs to ease burden of women; and viii) coordination with local education office for programs to improve literacy /numeracy of women, i.e., adult literacy/numeracy classes utilizing existing teachers in local schools.

## **2. PRESENT SITUATION OF SUBPROJECT AREA**

### **2.1 Socio-Economic Analysis**

39. Ban Haad Don Keo village was established in around 1887. The People are purely of the Keun Ethnic Group or Leu Ethnic Group classified under the Lao-Tai Ethno-Linguistic Group.

#### **(1) Livelihood Sources**

40. Village authorities reported that the main occupation of HHs in Haad Don Keo is agriculture crop production.

41. This is validated by the Interview of Sample HHs. The main source of income of HHs in the village is agriculture, mainly rice production. Based on the results of Sample HH interview, 90% of HHs are involved in agriculture production and 80% are involved in non-agriculture sources of income. The average HH income is composed of 92% from agriculture sources and 8% from non-agriculture sources. The average monthly per capita income is quite high at 1.09 million kips/capita/month. However, it must be noted that 20% of the sample household is classified as low income or poor.

#### **(2) Poverty**

42. The average monthly per capita income is quite high at 1.09 million kips/capita/month, however, it must be noted that 20% of the sample household is classified as low income or poor. Based on the Village HHs Masterlist poor HHs in the area is in the range of 10%.

#### **(3) Gender**

43. The leadership of the Village Administration as well as in Village Organizations are dominated by men, although membership is open to both men and women. Promotion of women representation in the leadership of organizations, the WUG, in the case of this subproject is a concern to be deal with.

44. Women primarily perform household Presponsibilities and are performing alongside with men responsibilities in agriculture production and in decision-making for the household.

#### **(4) Indigenous People**

45. The 152 HHs in Ban Hat Don Keo are all of the Lao-Tai Ethno-Linguistic Group and hence, no cultural or ethnic differences among the subproject beneficiaries.

#### **(5) Landless Households**

46. There are 6 landless households (LLHH). Two (2) of the LLHH are female-headed HHs (FHHs) and two are classified as poor HHs (not the 2 landless FHHs).

#### **(6) Female-headed Households**

67. There are 15 FHHs in the village. Two (2) are having rice deficits and one (1) is categorized as poor.

## 2.2 Present Agriculture

68. The strategy for Lao government, in which the proposed Project area is located, is to maintain and accelerate the pace of agricultural diversification and intensification with increased productivity per unit of land, improved value-added processing, and expanded marketing and sales for national and international trade and increased private sector investment, including that from foreign sources.

### (1) Land and Human Resources

69. Agriculture and agribusiness in Lao PDR remain characterized by (on the supply side) low productivity due to inefficient practices (e.g., traditional but out-dated planting, seed retention and water use systems), inadequate technology (especially in the rice, cash crops and tea planting, post harvest, processing and rice milling sectors), a lack of timely and adequate basic inputs (e.g., fertilizer and seeds), and (on the demand side) a lack of physical access to produce markets related to poor infrastructure.

70. Quantities of Lao agricultural commodities are exported through unofficial border trade mechanisms to Thailand, Viet Nam and China. The concerned commodities include maize, soybean, groundnut, cotton, sesame, red bean, cabbage, bananas, tamarind and water melon.

### (2) Land Ownership and Average Land Sizes

71. The total landholding of Houay Sat is roughly 255 ha with 149 ha in the uplands and 83 ha in the lowlands. The remaining land holdings are allocated to home gardens, perennial crops, fish ponds and rubber trees that are part of the government promotion of commercial/industrial and fruit tree plantations.

### (3) Crop Production

72. Rice farming Systems in this subproject are broadly 3 kinds of rice cultivation system, categorized by physical elevation above sea level, and by access to water.

73. **Upland rainfed (wet season) rice**, often found under a sloping land (under 15%) of agriculture, where areas have yields average less than 1 ton per hectare.

74. **Lowland, rainfed (wet season) rice** in areas away from rivers. These areas account for by far the largest portion of rice production in district. Individual plots are small, and the typical rice smallholder might have one or at the most two hectares of land that produce 2.0-2.5 tons/ha. The most common variety of rice is *khaonio* or “sticky” (glutinous rice with a high starch content) that appeals to the local market.

75. **Lowland, irrigated (dry season) rice** in areas served by canals constructed for the purpose. In the irrigated areas, yields may exceed 3 tons per hectare and it is from these areas that the marketable surplus arises. However, the area under irrigation is relatively small compared with other lowland rice areas.

76. **Other Crops:** Yellow corn and Job'stear are considered a major crop in Houay Sat because it is grown on a large scale on the upland and highly traded export to Thailand and China. Leaf vegetables, garlic, and chilli were planted only small parcels (about 500 to 1,600 square meters) whose ecosystems are generally favorable for the cultivation of such crops, mainly for home consumption and the rest for sale in markets near the village.

#### **(4) Livestock Production**

77. Large animals notably cattle (population above 100 heads) are significant in most villages. Swine and chicken are generally reared as the most immediate source of food and household income. Yellow corn production in upland and lowland area is very important as a major source of feeds and the improvements in cattle health and mortality would be an important way of increasing incomes.

#### **2.3 Existing Irrigation System**

78. There are 6 weirs in Houay Sat, namely: 1) Pakhouaykhan; 2) Fai Houanar; 3) Fai Phouvat; 4) Pakhouay ngat; 5) Napoung; and Hangnar. All the weirs are owned and managed by the villagers of Haad Don Keo. Phouvat is a concrete weir constructed by the government with labor participation of the villagers. All the other 5 weirs are indigenous wooden weirs constructed and maintained by the water users.

78. There is an existing informal WUG in the area with about 33.60 ha (WS) and 38 HHs in Phouvat and 42.50 ha (DS) and 51 HHs in Napoung weir. The water discharge in Napoung is quite dependable. During the dry season, Phouvat is reported to have irrigated about 25 ha and Napoung had irrigated more than 32 ha.

79. The water users do repair and maintenance works usually once every season and that is before the start of water delivery for each season. During the dry season, the farmers in Phouvat had experienced delivering water to section of the system by schedule/rotation and irrigated more than 20 hectares.

80. The existing WUG according to interviews, is weak and needs to be established as Water Users' Association (WUA) and given training on: i) WUA management; ii) financial management; and iii) operation and maintenance of irrigation system. The WUG never had collected any water fees to support the O&M of the irrigation system.

81. The subproject will be turned-over to the WUG after completion. To ensure sustainable operation and maintenance (O&M) of the irrigation system, the WUG must be strengthened and assisted in setting up irrigation fee collection rates and system to raise funds for O&M.

82. The cropping system in both irrigation systems is rice-rice. Farmers claim that they can plant other crops like peanut, watermelon, pumpkin, etc. but they need to be trained on the appropriate crop production technology and must be supported in marketing their produce. Farmers usually use traditional rice varieties and reported yield up to 4.00 tons per hectare.

83. The main problem of farmers in the area is the bad road (difficult land transportation) and marketing. They rely on local traders coming to the village to buy their surplus rice. They produce Job's tears in upland areas but these are also bought by local traders for export to Thailand. Due to the difficult transportation, the price of agriculture produce is low. Alternative transport is through the Mekong River by boat.

#### **2.4 Other Development Agencies**

84. There are currently eight NGOs operating within Paktha District covering a wide range of sectors from health, education, conservation, human trafficking and agriculture. Oxfam and German Agro Action (GAA) are the only two NGOs working in agriculture related sectors. Both Oxfam and GAA's activities will cease at the end of 2012, so there is little scope for coordination. Government agencies such as the Lao Women's Union and the Lao National

Front for Construction are the potential development partners that can assist in the implementation of subproject activities in terms of facilitation particularly on gender mainstreaming activities.

## 2.5 Subproject Justification

85. The subproject was initially proposed as part of the shortlist list of potential subprojects by the province through the provincial planning process which is based on the provincial five-year economic development plan.

86. As part of the feasibility study, several visits were also made to the subproject site to discuss the proposals with the villagers, village, district and provincial authorities. In all, two visits were made to the subproject as follows:

### Village consultation meetings during feasibility preparation

Date	Villages represented	Discussion
17 July 2012	Ban Haad Don Keo	Introductory visit to appraise the villagers of the project and proposed activities in the subproject. Consultation with villagers on current issues and concerns.
20 November 2012	Ban Haad Don Keo	Introduction/briefing/discussion on LARC aspects to village residents by provincial, district and consultant staff complementary to joint transect walks undertaken in the subproject's implementation area.

87. As reported in **Annex 7 Social Impact Assessment**, overall, the villagers support the proposed subproject. Technical and financial assessments have identified the subproject as both technically and economically feasible (see **Annexes 2 and 6**).

### 3. SUBPROJECT DESIGN

#### 3.1 Subproject Development Plan

##### (1) Irrigation Development Plan

88. The proposed irrigation development plan is composed of i) improvement of Fai Phouvat (No.1 weir), its canal and related structures, ii) improvement of Fai Napoung (No.2 weir), its canal and related structures, and iii) improvement of farm to market road.

89. The improvement of Fai Phouvat (No.1 weir) includes i) construction of spillway, ii) installation of intake and sluice gates, iii) concrete lining of main canal (1,200 m), and iv) construction of canal related structures such as division structure, drainage inlet, drop structure, turnout, and end structure.

90. The improvement of Fai Napoung (No.2 weir) includes i) construction of KCU-Lao concrete weir, ii) installation of intake and sluice gates, iii) concrete lining of main canal (2,550 m), and iv) construction of canal related structures such as check structure, division structure, drainage inlet, turnout, drainage culvert, road crossing culvert, and end structure.

91. The farm to market road with a total of 5,000 m will be improved by laterite pavement.

##### (2) Agriculture Development Plan

92. The extension process and marketing system to achieve the subproject will have activities. All activities will be carried out by the staff of the DCO with support from the PPO and project advisors.

93. Technologies will be introduced to farmers for their assessment similar to farmer field school approach. The project will provide limited quantities of agricultural inputs for rice and crop demonstration to transfer the new techniques to farmers and more important in this phase will be field based 'follow-up' by DAFO staff. During follow-up, the farmers will interact as a focus group to exchange experiences. At the end of the season this group will report their experiences back the large interest group, for expansion. The process of expansion within a village will be supported each year with village planning activities. Follow-up, in addition to supporting farmers in technical difficulties will focus on identifying cases where farmers begin to gain impacts at an early stage.

94. **The use of improved varieties**, particularly the early maturing and HYV offers the best potential to increase the yield of paddy rice. Demonstration farms will be established to showcase the growing of improved varieties with high yielding.

95. **Rice seed multiplication** is very important to produce the seed with uniform quality and yield. For paddy rice irrigated, the immediate intervention would be to use improved varieties. Early maturing and high yielding varieties, especially those resistant to pest and diseases would be promoted.

96. **The paddy rice yield** is projected to increase about 62% during wet season and 60% during dry season. Higher yield increase is projected in the dry season. With the project, total irrigable area (physical area) is 92 ha. Effective crop area, defined as the sum of the wet and dry season areas. The cropping intensity was projected to reach by 170% at full project development.

97. **Crop diversification and high value crops** on a modest scale would be demonstrated to supplement the income of the farmers. Demonstration farm of production



techniques would be established right in wet and dry season to improve the technical knowledge of farmers.

98. **SRI:** a technology based on labor intensive and controlled used of fertilizer and other farm inputs would be introduced to those subprojects whose farmers have achieved a modest level of technology in rice production and seed multiplication

99. **Marketing and value added,** farmers will begin to coordinate sale of their stock in villages through Farmer Production Group, which will improve their negotiation position with traders. Coordination between farmers within subproject for coordinated marketing will drive on-going networking. Along with networking for marketing, farmers will also exchange technical information on production technologies. Greater market knowledge will stimulate farmers to increase their production and as a result demand improved technologies in order to respond to the market.

100. **Annex 3** shows detailed the present agricultural situation and agricultural development plan that will be support activities for subproject successfully after completion of irrigation rehabilitation.

### **(3) Associated Initiatives**

101. Three associated investments are proposed to enhance the impact from the investment and ensure sustainability of its benefits and include: (i) support for WUGs /WUAs strengthening program and established to operate and maintain the rehabilitated facility, (ii) resourcing existing technical extension services to introduce modern production technologies, and (iii) catchment zoning and village land-use planning to ensure sustainability by limiting the extent of siltation in the reservoir.

102. **Strengthening for WUG/WUA.** Through the discussion of PAFO and DAFO, WUG/WUA strengthening program should be undertaken during the project implementation period. The training of WUG/WUA for reorganization, election of WUA executive committee, role-rule and regulation, financial management, O&M of the irrigation system, establishing of Farmer Producer Groups (FPGs), management and participation in subproject implementation is very important to facilitate the work plan. The estimated cost is about US\$ 11,000.

103. **Land Use Planning.** The land is divided into two parts by weir point, the upstream catchment and downstream irrigation land. The land use change detection and land use protection are important to upstream catchment for keeping sustainable water use in the future. On the downstream irrigation land, the tasks of Land Use Planning are to establish a GIS database through GPS survey for managing irrigation block. The GIS database can support and strengthen WUA for water fee collection and other management of water use matters. The estimated cost is about US\$ 11,000.

104. **Agricultural extension and marketing.** According to the discussion with the villagers and their proposals is the training on crop production techniques and processing techniques, marketing study, value chain development plan very important to add value of products, in country study tours, field visits and farmer field school. The strengthening of farmer knowledge with their requirements will be possible to increase the crop yield, add value of commodities and receive more family income. The improving of agricultural product quality is the main opportunity for export marketing, so the post-harvest equipments and processing techniques in farmer level is very important and necessary to support with the estimated cost of US\$ 23,000.

105. Associated costs have been estimated based on specialist opinion from the design team in consultation with PAFO, DAFO agricultural staff and farmers. The total cost of

associated activity development used in subproject is about **US\$ 45,000** detailed in **Annex 4**.

### **3.2 Social and Environmental Safeguards**

#### **(1) Land Acquisition and Resettlement**

106. At feasibility study stage, the rehabilitation works of this subproject will result in:

- Loss of agricultural land of about 3,189 sqm productive land owned by 8 households for whom this would represent a loss of 3.3% of their total productive land. There is one household severely affected by losing about 13% of his paddy fields;
- Loss of 91 trees owned by 3 out of the 8 farmers who would lose about 30% of their total trees they own;
- No loss of residential land;
- No loss of primary and secondary structures;
- No relocation of households;
- No loss of common property;
- No cases of economic resettlement and vulnerable people caused by the subproject.

107. Thus the land acquisition, resettlement and compensation impacts and mitigation measures respectively are estimated at 45 million Kips.

#### **(2) Environment**

108. The IEE study for the subproject was carried out by the PPDO, DPO staffs and the NRI-GIC Environmental Consultants, following the Environment Policy, Environmental Assessment Guidelines, and Environmental Guidelines for Selected Infrastructure Projects of the Asian Development Bank (ADB), and relevant environmental policies and guidelines of the Government of Lao PDR.

109. The Environmental Specialists in collaboration with the multi-disciplinary NRI Consultants preparing the Feasibility Report for the subproject were made aware of the environmental screening process using the ADB Rapid Environmental Assessment (REA) Checklist and provided the PPO and DCO staffs with the checklists prepared in Lao Language for screening of the impacts. The NRI-GIC consultants and Environmental Specialists visited the subproject sites and also carried out public consultations prior to preparation of this report. Moreover, information provided by Consultants carrying out Feasibility Study was used in this exercise.

110. Thus the IEE Study involved the following activities in each of the subcomponents:

- Gathering and collation of baseline information available on the physical, biological, chemical, and socio-economic environment of the subproject area and subcomponent sites (i.e., main canal and secondary canals; and understanding the technical, social, and institutional aspects of the subprojects; this included public consultation meetings participation during the subproject field visits;
- Screening of potential issues, concerns and impacts relative to siting, design, construction and operation to distinguish those that are likely to be significant for a particular subcomponent and warranting further study;

- Recommending measures to mitigate adverse issues, concerns and impacts, particularly to the project design team
- Preparation of an Environmental Management Plan indicating impact areas, recommended mitigation measures, method of monitoring the impacts and responsible persons ; and
- Proposing an environmental monitoring plan (EMP) and the institutional set up for implementation of the above Environmental Management Plan.

### **(3) Gender**

111. A Gender Action Plan was developed for the subproject based on the Project-Wide Gender Action Plan. The main concern of the plan is the promotion of the involvement of women in subproject activities and their representation in the village administration committees/units and village organizations. In the case of this Subproject, 30% women representation in the WUA Executive Committee is specified, as well as attendance in subproject consultation forums, meetings, trainings and study tours.

### **(4) Indigenous Peoples**

112. An Indigenous People's Plan (IPP) was developed for the subproject based on the Indigenous People Planning Framework (IPPF) for NRI. The main concern of the plan is the promotion of the involvement of ethnic minorities in subproject activities. The hiring of labor during the construction of the subproject is also specified to give priority to local people to include ethnic minorities and priority to members of poor and vulnerable households. For this Subproject, the representation of ethnic minorities in the WUG Executive Committee and membership is specified.

#### **4. INVESTMENT COSTS**

113. The investment cost of Houay Sat subproject totals US\$547,460 and consists of:

- Survey, design and construction supervision;
- Civil works;
- Associated initiatives; and
- In-direct investment costs including i) vehicles and equipment, ii) consulting services, and iii) training, studies, operating costs, etc. for project implementation.
- Physical contingency

##### **4.1 Methods of Cost Estimation**

114. In line with normal practice, the survey and design cost is estimated at 12% of the total civil works costs.

115. Civil works requirements have been based on the need for rehabilitation/improvement determined through village consultations and discussions with PPO and DCO and site investigations. Proposed work items were identified through a review based on priority, urgency and economical effectiveness. Unit price used for the estimates are based on an average of recent unit rates used in similar schemes as recorded by the province.

116. Detailed requirements for associated initiatives are not yet available as the detailed requirements for associated will need to be developed with full participation from the villagers which will be carried out during subproject implementation. Preliminary budgets for both compulsory and optional initiatives are given in **Annex 4**.

##### **4.2 Capital Costs**

117. The capital costs of the subproject comprise of direct and indirect costs. The direct costs comprise of the survey and design, construction and associated initiatives that are designed to ensure full benefits of the investment. The civil works component account to 67% of the total subproject costs, while the total direct costs (civil works and associated initiatives) make up 83% of the total subproject costs.

118. Indirect costs associated with the implementation support to the project which includes consulting services provided by the grant implementation consultants (GIC); vehicles and equipment provided by the project and training and studies. The indirect costs amount to 15% of the total subproject costs. The remaining 2% of the subproject cost is allocated as physical contingency.

##### **4.3 Operational Costs**

119. The project aims to turn over the irrigation system to the water users group (WUG) when ready for operation. It is expected then that they will operate and maintain the physical facilities of the system. The cost for minor repairs and maintenance should be shouldered by them.

120. However, cost for major repairs of the structures should be the responsibility of the government. The annual Operation and Maintenance (O&M) Cost is estimated at 10% of the direct cost equivalent to US\$43,744.

## **5. IMPLEMENTATION ARRANGEMENTS**

### **5.1 Execution and Implementation Agencies**

121. The executing agency for the subproject will be the provincial governor's office of Bokeo that will delegate responsibility to PAFO for subproject implementation. Bokeo PAFO has designated the PPO established within its premises to maintain responsibility for day to day implementation and monitoring of the subproject. Recruitment of consultants for detailed subproject preparation will be carried out by the NPMO while works contracts will be procured by the NPMO based on provincially and NPMO certified designs. The Irrigation Section and the Planning Section of Bokeo PAFO will be involved in the technical aspects of design as well as in the approval for further processing of the subproject. Associated initiatives will be delivered by established DAFO offices under performance based contract to the PPO.

#### **(1) Construction Phase**

122. Subproject management will be carried out by the PPO with the assistance of the DCO in Paktha. Although NPMO will be the Employer for the civil works contract, the PPO and DCO are expected to assist in implementation and management of the contract. Training will be provided to local staff at both provincial and district level in contract management to ensure quality control and timely delivery of outputs. Routine reporting will be maintained by the DCO and PPO to NPMO, MAF and ADB as part of its routine reporting responsibilities.

#### **(2) Operational Phase**

123. Upon completion of the works, the commissioned scheme will be handed over to Paktha District where it will be registered as an asset of the District. At that stage, the District Governor's Office will assume responsibility for scheme maintenance.

124. However, the formation of WUGs will provide an operational mechanism that will be managed by the beneficiaries and funded by beneficiary contribution through water user fees as is consistent with Lao PDR Irrigation Management and Transfer Strategies. The Project will also provide support in these functions in order to sustain the benefits from rehabilitated irrigation facilities. Periodic maintenance will require inputs from the province and, according to the Grant Agreement, the provincial authority is required to sign an MOU with the Project (Schedule 4, paragraph 21 of the Grant Agreement) to ensure sufficient funds for the periodic maintenance of the system.

### **5.2 Subproject Implementation Management**

125. Overall Project implementation responsibility lies with the NPMO. The implementation of the subproject level, however, is with Bokeo PAFO. PAFO will supervise PPO in all project implementation activities including reviewing of workplans and budgets. PPO will directly monitor project implementation progress as well as project impacts and benefits. PPO will also support the survey and detailed design of the scheme and raise awareness and disseminate information regarding the project and subproject within the district and to all relevant stakeholders. DCO is responsible for working directly with the communities in development of the associated initiatives, coordination on safeguard activities, and direct monitoring of subproject implementation.

126. **Figure 1** summarizes the implementation management arrangement for the subproject including responsibilities.

### **(1) Implementing Agency Capacity for Implementation**

127. As is the case with many district government staff, there is an overall shortage of relevant qualified staff. Many are appointed to positions to which they don't have the relevant experience. **Table 2** shows a summary of PPO and Paktha DCO staff who have responded to questionnaires on capacity assessment.

128. For staff in Paktha district, 50 percent have no relevant qualification and 75 percent have less than two years of relevant experience to the position in which they have been assigned. 75 percent of the district staff in Paktha have a total general work experience of between 2 to 5 years. As such, it is unlikely that they would be familiar with management aspects of project implementation and safeguards issues for which training activities will be developed and implemented to match the needs.

#### **5.3 Implementation Schedule**

129. Following the approval of this Feasibility Study, it is envisaged that the detailed survey and design for the subproject can commence at the middle of the 2<sup>nd</sup> Quarter 2013 or later depending on the procurement process. Procurement for the construction works is expected to be finalized by the end of 2013 and construction works to commence within the 1<sup>st</sup> Quarter of 2014. Construction works is estimated at 18 months.

#### **5.4 Procurement**

130. Based on the original procurement plan, three sets of packages will be required to implement the subproject: (i) national consultants for detailed design, bid document preparation, and supervision of construction, (ii) civil works construction contracts, and (iii) service contracts to implement associated initiatives. Procurement associated with the subproject will be recruited and/or managed by the NPMO.

131. Procurement methods will be in accordance with those specified in the Grant Agreement for the overall Project.

#### **5.5 Monitoring and Evaluation Reporting**

132. Three different kinds of monitoring will be carried out including: (i) implementation progress monitoring of the subproject, (ii) safeguards monitoring, and (iii) benefit monitoring and evaluation.

133. Implementation progress monitoring will be one of the main tasks of the PPO. This will be undertaken by a monitoring officer appointed to the PPO and activities will be based on the subproject implementation schedule (**Figure 3**).

134. Safeguard monitoring with associated grievance mechanisms will be developed to ensure that the required policies, procedures and plans for: (i) resettlement including land acquisition and compensation, (ii) EMP plan implementation, and (iii) that the GAP will be followed. A safeguard officer will be appointed to the PPO to undertake this task for internal monitoring purposes. In addition, an independent agency will be recruited to specifically monitor the implementation of land acquisition and resettlement activities to ensure full compliance with all laws, decrees, policies and plans and to review the grievance mechanism for affected persons as part of the external monitoring process. The independent agency will be required to include in their teams staff from institutions such as LWU in order to assist in the building of capacities at the local level.

135. The appointed staff for safeguards monitoring has a forestry background and no specific experience in safeguard issues except as related to forest environments. GIC staff

will need to assist the staff in carrying out safeguard monitoring activities initially until the staff has gained sufficient experience. The staff will be required to attend two training sessions to cover topics related gender, indigenous peoples, resettlement and environmental issues and monitoring which are scheduled in the capacity building programs.

136. An overall Project benefit monitoring and evaluation system has been established and relevant subproject DCOs are tasked with the periodic monitoring of the benefits and impacts of the subproject.

137. All reporting will be submitted from the DCO to PPO and then form part of the routine reporting requirements of the PPO to the NPMO and provincial authorities. The NPMO will aggregate progress reporting of all the subprojects and submit routine quarterly reports to the national government and ADB.

## 6. IMPACT

### 6.1 Social Impact

138. The proposed subproject has the following potential impacts:
- a. increase household income and hence, reduce poverty;
  - b. improvement of the economic conditions of beneficiary households due to: a) improved irrigation water availability in irrigated areas; b) increase in irrigated area in both season; c) increase rice yield and production; d) promote production of high value crops during the dry season; and e) increase in income;
  - c. generate additional demand for hired labor due to increase in crop production activities in the area for two seasons; and
  - d. promote a more active economy for the villages due to increased production of rice and other crops, increased household income, potential commercialization of rice surplus and high value crops, and demand for production inputs.
  - e. Savings in labor, time and local materials for the beneficiary households from the 3-4 times repairs that has to be done on the existing indigenous weirs particularly during the wet season.
  - f. The proposed subproject is preliminary determined to have a minimal impact on the lands of 5 households (1.4% of total HHs' land area) but will have no impact on crops and permanent structures. The affected lands will be firmed-up during the detailed design phase and will be subjected to consultation and negotiation with the affected households (AH) to agree on the form of compensation or mitigation measures before subproject implementation.

### 6.2 Economic Evaluation

139. The Houay Sat Irrigation Rehabilitation Subproject is economically feasible and a go project with an economic internal rate of return (EIRR) of 13% evaluated at 30 year period. By applying the interest rate of 12% as the opportunity cost of capital for Lao PDR, the net present value (NPV) in terms of dollar is US\$ 23,714. The EIRR was further subjected to possible events that may adversely affect the project viability. Two possible changes in key variables include the following:

140. **Investment Cost:** Cost estimates are more or less computed accurately at present price levels however, it may vary in the actual cost and will rise higher. Thereby, a twenty percent increase in costs is assumed in the sensitivity analysis. With this increase the estimated EIRR is 10%. This means that the project is marginal.

141. **Direct Irrigation Benefits:** Sufficient irrigation water is available during the wet season and it can supply the crop water requirement for the whole command area. However, during the dry season irrigation water supply may not be enough to irrigate the whole command area thereby diversified crops is introduced. The present cropping intensity is 118% and the assumed cropping intensity in the future with the project is 181%. A 20% decrease of benefits is assumed to occur in the future because of no assurance of dependable water supply and other contributing factors like farmers adoption of modern farming practices, climatic condition in the area. The resulting EIRR is 9% which is also marginal.



142. The results of economic evaluation indicate its attractiveness for investment. However, if the basic assumption are not attained it may be at risk. The investment cost seems to be reasonable at US\$2,319 per hectare but if it can be reduced the economic viability will be higher.

**Table 6-1: Economic Returns for Irrigation Rehabilitation**

Particular	Net Present Value @12 %	EIRR
Normal Scheme	US\$ 23,714	12.54 %
Sensitivity Case:		
20 % increase in investment cost		10.49 %
20 % decrease in benefits		9.92%

### 6.3 Environmental Impact

143. This subproject is one of the Year 2 subprojects selected to contribute to poverty reduction and improve the quality of life and the environmental conditions of the rural population in the Province of Bokeo through sustainable improvement of the irrigation system.

144. Findings of site reconnaissance, results of social surveys, resettlement surveys subproject descriptions based on the engineering designs, available land use data and discussions with the subproject beneficiaries and Officers of the relevant MONRE, DARF officials were integrated into the IEE Report.

145. The potential environmental impacts identified to be associated with the irrigation system improvement were identified during the Pre-construction period mainly due to the proposed location and design of the weir. Most of the impacts will be generated during the construction period. Although they are considered to have minimal impacts however, without proper and timely implementation of the mitigation measures could possibly cause significant negative effects to the environment and to the overall sustainability of the subproject. The potential impacts of the subproject and its corresponding mitigation measures are proposed in the EMP to include the following:

146. **Pre-construction phase (Impacts due to location and/or design):** i) Inundation of existing paddy fields; ii) loss of access used farmers' using hand tractors; iii) involuntary resettlement and compensation due to improvement of canal system; iv) Health and safety risks of workers.

147. **During Construction (concrete weir and canal system):** i) Soil erosion, silt and sediment deposition; ii) obstruction of water flows in the canals from sediment or other deposits; iii) dust nuisance; iv) inefficient use and distribution of irrigation water; v) use of land for storage and as works depots.

148. **During Operation and Maintenance:** i) Competition/disputes for use of irrigation water and with other water uses; ii) obstruction of water flows in the canals from sediment or other deposits; iii) effects of intensified use of chemical fertilizers and pesticides.

#### (1) Proposed recommendations/Solutions for the Potential Impacts

149. In general, the subproject will generate positive impacts to the environment. However, negative impacts cannot be avoided. As a result, in order to bring into full play positive impacts and minimize negative ones, following measures should be followed:

150. **Pre-construction phase:** i) Implement resettlement and compensation plan In accordance with the requirements of the ADB and the Government; ii) Provision of a raised embankment in the immediate area of the concrete weir; iii) Preparation of plans by the

Contractor: allocating responsibilities for safety; health and welfare to senior staff; first aid and emergency procedures; satisfactory accommodation of workers; information and instruction dissemination to workers regarding risks of diseases.

151. **During Construction:** i) Provision of silt and sediment traps where needed; ii) Careful supervision of the works (confining excavation works to the dry months), (ii) reuse of surplus spoil, distribution to users in or near the subproject area, or disposal at a site approved by the PAFO / PPO; iii) wetting of excavation sites and stockpiled material during dry and windy weather, when within 50m of an occupied dwelling; iv) use of temporary diversions using pipes and pumps where necessary; involve WUGs in planning of the works; v) form agreements with the landowners, and restoration of land to former or better condition according to agreements with landowners.

152. **During Operation and Maintenance:** i) reliable collection of information on water levels in the canal system, to enable sound planning and water use and distribution among WUGs; ii) provision for IEC program for the WUGs on the proper operation of the irrigation system and how to effectively regulate irrigation water use; iii) instruction in purchase and use of pesticides; iv) promotion of the informed use of mineral fertilizers; v) promotion of the concept of integrated pest management, and; vi) emphatic discouragement of the use of persistent pesticides.

## **7. CRITICAL RISKS**

### **7.1 Main Risks**

153. Possibly the single greatest risk relates to sustainability of benefits from irrigation rehabilitation. If the local administration can ensure adequate levels of maintenance funding for the more significant items, the benefits should be assured as the lower routine maintenance costs will be recovered through water charges. Historically, this would appear unlikely. The actual situation with which the province and district is faced today is due, in part, to its inability to maintain the irrigation scheme in full working order. This situation is unlikely to change within the effective life of the investment. The implication from this fact is that there is an immediate need for cooperative action by the beneficiary farmers in the area to organize contributions to maintain the headworks in preparation for a catastrophic event. While farmers are obliged to pay water user charges to cover routine operations and maintenance costs, they are the ones to gain from joint action to ensure the operation of the system and even contribute to a longer term periodic maintenance fund after the scheme is operating successfully.

154. The sustainability of the investment is not only dependent upon the effectiveness of the WUGs to generate maintenance budget, but also on the stabilization of the land use in the catchment immediately above the weir will reduce the level of siltation in the weir and extend its economic life. There are some shifting cultivation lands in the catchment area, where stabilization of shifting cultivation should be practiced such as introduction of cover crops, contour planting and hedgerows.

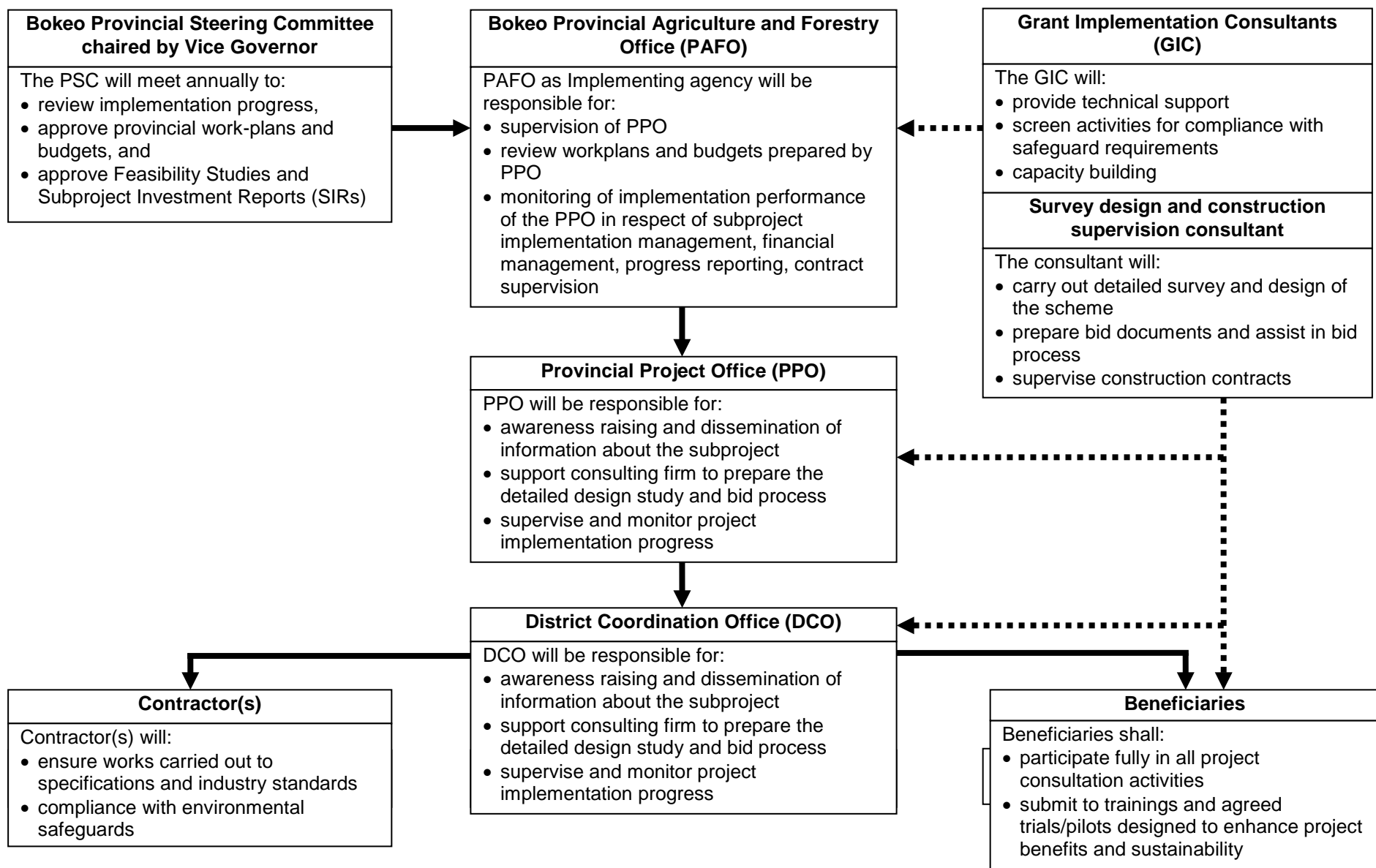
155. In the associated initiatives, the WUG strengthening activities are intended to address the 1<sup>st</sup> critical risk while the catchment management plan will not directly contribute to the 2<sup>nd</sup> critical risk but indirectly contribute to the preparation of the district land use plan.

# ***Tables***

**Table 1 Implementing Agency Capacity Assessment Summary**

	DCO			PPO	Total
	Pha Oudom	Paktha	Houaysai		
<b>Work experience</b>					
≤ 2 Years	-	-	2	-	2
2-5 Years	3	3	1	1	8
5-10 Years	-	1	1	2	4
> 10 Years	1	-	-	3	4
<b>Qualification</b>					
Degrees	1	-	2	2	5
High Diploma	-	1	1	3	5
Diploma	3	3	-	1	7
Secondary education	-	-	1	-	1
<b>Relevant qualification to appointment</b>					
Yes	3	2	2	5	12
No	1	2	2	1	6
<b>Relevant to experience to appointment</b>					
≤ 2 Years	3	3	4	-	10
2-5 Years	1	1	-	4	6
5-10 Years	-	-	-	-	-
> 10 Years	-	-	-	2	2

## ***Figures***



**Figure 1 Summary of Subproject Implementation Management**

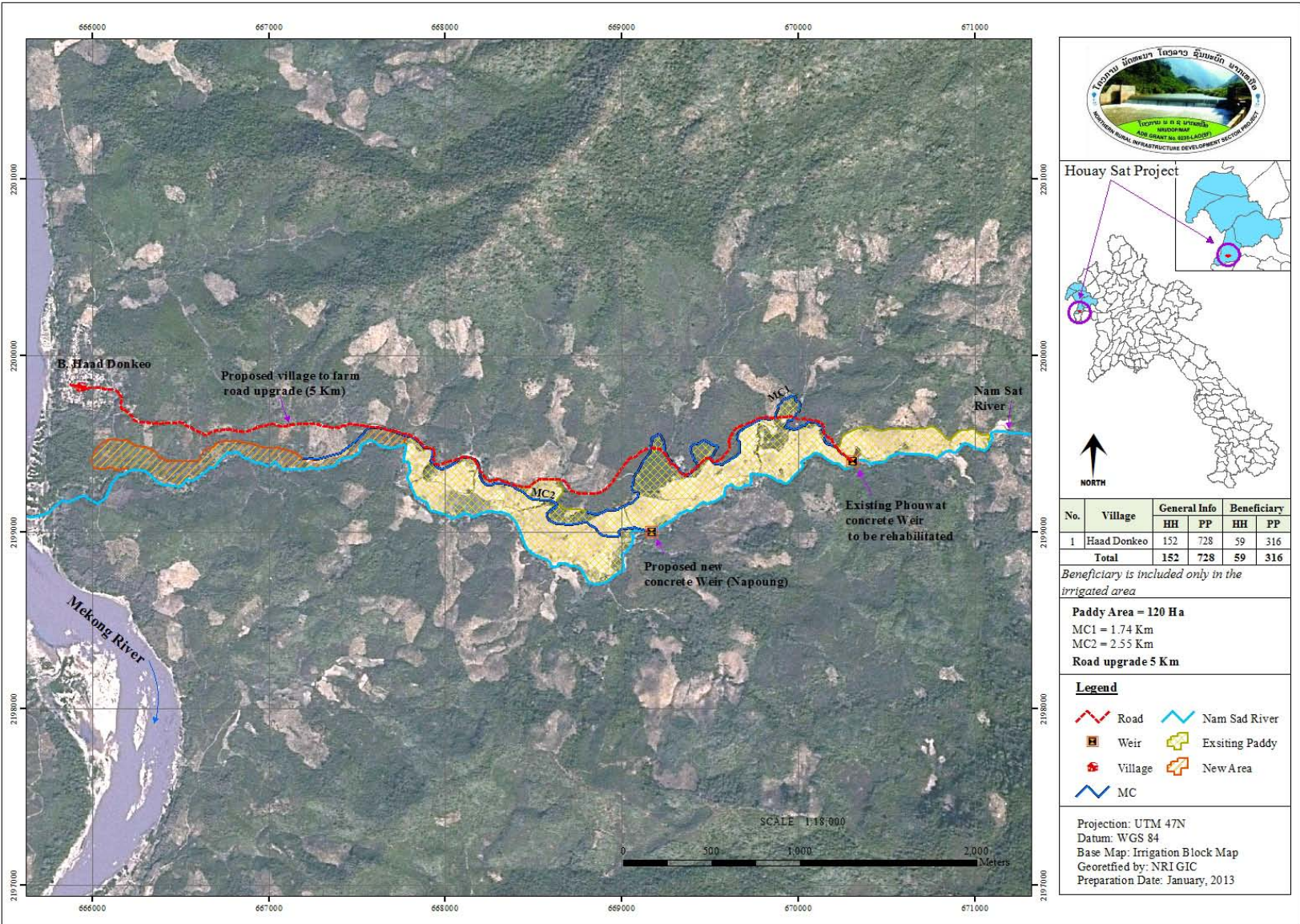


Figure 2 Map of Houay Sat Subproject



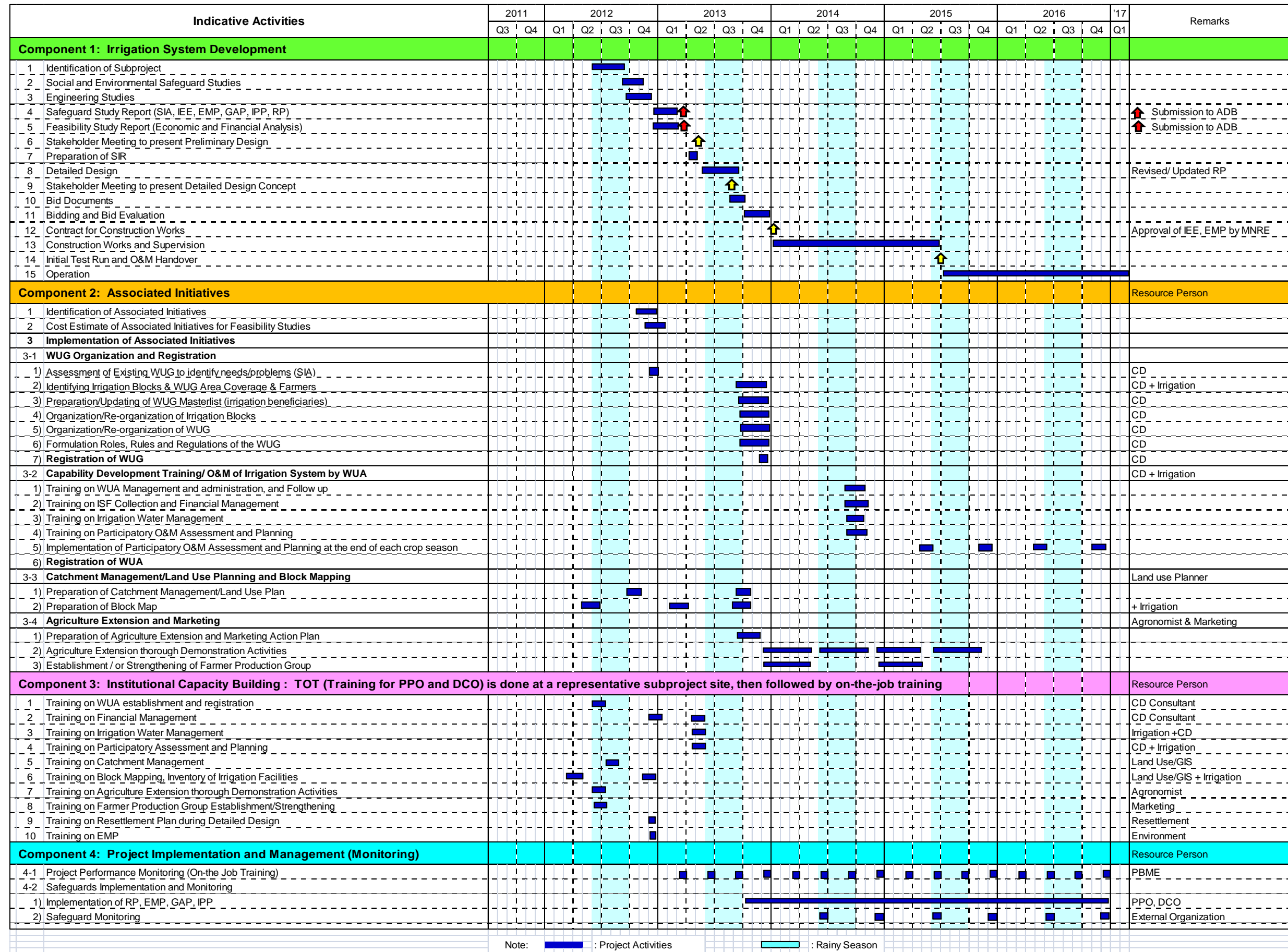


Figure 3 Implementation Schedule of Houay Sat Subproject

# ***Annexes***