3. PROJECT ACTIVITIES AND OUTPUT

3.1 Kick-off

At the explanation and discussion of IC/R with Lao side, overall approach of the project described in IC/R was agreed by both sides, therefore Minutes of Meeting (M/M) was signed by Project Manager (Lao side) and Chief Advisor of JICA expert team (Japanese side) on November 18, 2010 as shown in Appendix-2. During discussions, Director General of DoW requested to Japanese side to cover the cost related to surveys required for the construction of pilot project such as topographic survey and boring test, and also for the cost related to the implementation of project activities by Lao side such as utilities of project offices, transportation fee/ daily allowance/ accommodation fee of C/P officials.

Photo 3.1-1 Signing on M/M on Discussion of IC/R

Regarding the kick-off meeting, actual holdings were five (5) times in total at all target provinces (Bokeo, Bolikhamxay and Luangprabang) as well as Vientiane Capital, where the kick-off meetings were held for internal and public as shown below.

November 24, 2010: Internal Kick-off Meeting (Vientiane Capital)

November 26, 2010: On-site Kick-off Meeting (Bolikhamxay Province)

November 29, 2010: On-site Kick-off Meeting (Bokeo Province)

December 6, 2010: On-site Kick-off Meeting (Luangprabang Province)

December 10, 2010: Public Kick-off Meeting (Vientiane Capital)

Originally the kick-off meetings were planned to be held twice in Vientiane Capital and Bokeo Province only, eventually, however, it was beneficial to ensure that all relevant officials were informed about the project contents in early stage of the project.

In total 24 participants attended the public kick-off meeting on December 10, 2010. They were the

Director General as the head and nine (9) officials from DoW, six (6) officials from three (3) provinces and Vientiane Capital of DPWT, two (2) officials from JICA Laos office and one (1) JICA expert dispatched to MPWT, including one (1) translator and five (5) JICA experts delegated for the project.

Photo 3.1-2 Internal Kick-off Meeting (Vientiane Capital)

Photo 3.1-3 On-site Kick-off Meeting (Bolikhamxay Province)

Photo 3.1-4 On-site Kick-off Meeting (Bokeo Province)

Photo 3.1-5 On-site Kick-off Meeting (Luangprabang Province)

Photo 3.1-6 Public Kick-off Meeting (Vientiane Capital)

3.2 Evaluation Criteria for Level of Understanding

Grade of ability improvement of C/P officials were obtained as quantitatively as possible by comparing their level of understanding at the commencement point of the project with the level at the time when the project is completed in its each year through quizzes, papers, interviews, etc. The target persons were C/P officials in DoW, MPWT, DPWT of Vientiane Capital and three provinces of three (3) target group.

Level of C/P officials' understanding must be evaluated fundamentally based on the abilities required for each official's duties as described in 1.6.2 in Chapter 1 because C/P officials of MPWT and C/P officials of DPWT of Vientiane Capital and each province have different roles.
However, because C/P officials of MPWT are expected to grasp the process of works required for C/P officials of DPWT of Vientiane Capital and each province to understand such as Design, River Survey, and Monitoring, these items of abilities were additionally included in the evaluation criteria for level of understanding for C/P officials of MPWT.

3.2.1 Establishing "Evaluation Criteria for Level of Understanding"

(1) Methods of obtaining information for evaluations

Information for evaluations was obtained by the following methods.

(a) Investigation by documents such as Curriculum Vitae (CV).
(b) Level watching by routine discussions, etc.
(c) Grasping the level by short test, short paper, and interviews.
(d) Grasping the level through the surveys in surrounding provinces.
(e) Grasping the level by work outcomes in the project.

(2) Items of evaluation

Level of understanding was evaluated for each required ability as below.

(a) Participating attitude to the Project
(b) Basic knowledge on hydrology, hydraulics and river engineering
(c) On-site practical abilities
(d) Ability in Design
(e) Ability in River Survey
(f) Ability in Monitoring
(g) Ability in Maintenance
(h) Ability in Construction Supervision

(3) Evaluation criteria for level of understanding

Evaluation criteria for level of understanding were established as shown in Table 3.2.1.
Evaluation was done for each required ability and based on the level of understanding of individual C/P officials. However, the evaluation in this project was expressed as the level of whole group of C/P officials of MPWT and C/P officials of DPWT of Vientiane Capital and three (3) target provinces.
The level of understanding was evaluated by giving scores according to the above-mentioned Methods and Items on the basis of a perfect score of 100 points as shown below.

- 50 points indicates the capacity level of fair (requires some guidance from Japanese expert(s).
- 75 points indicates the capacity level of self-sufficiency as relatively high.
- 100 points means the capacity level of excellent.

Target score for each item is 75 points and higher for both group of C/P officials from MPWT and DPWT by the time of the project termination (refer to Table 1.4-2).

Table 3.2.1 "Evaluation Criteria for Level of Understanding" and Evaluation Method

Required Abilities	Evaluation Criteria	Methods of Obtaining Information for Evaluations
1. Participating attitude to the Project	[C/P officials are to realize their role, determine what they shall do, and perform their role.] ▪ They are quite all right; score 100 ▪ They often perform without any instruction/suggestion; score 75 ▪ They can perform when instructed/suggested; score 50 ▪ They rarely perform even though instructed/suggested; score 25 ▪ They can not perform at all even though instructed/suggested; score 0	▪ Routine discussion, etc.
2. Basic knowledge on hydrology, hydraulics, and river engineering	[C/P officials are to understand basic matters necessary for the riverbank protection, and explain them to others.] ▪ They are quite all right; score 100 ▪ They can explain about half of necessary items sufficiently; score 75 ▪ They understand about half of necessary items but can not explain them sufficiently; score 50 ▪ They do not understand about even half of necessary items; score 25 ▪ They do not understand necessary items at all; score 0 (Unidentified matters shall be presumed by results of baseline evaluation.)	▪ Routine discussion, etc. ▪ Short test, short paper, interviews (CV shall be referred to for baseline evaluations)
3. On-site practical abilities	[C/P officials can execute site selection, survey and planning for riverbank protection measure against erosion.] ▪ They are quite all right; score 100 ▪ They can do without help about half of necessary items; score 75 ▪ They can do with help about all of necessary items; score 50 ▪ They can not do even with help about half of necessary items; score 25 ▪ They can not do at all; score 0 (In case of no acquisition of basic knowledge; score 0) (Unidentified matters shall be presumed by results of baseline evaluation.)	▪ Routine discussion, etc. ▪ Result of Surveys in surrounding provinces (CV shall be referred to for baseline evaluations)
4. Ability in Design	[C/P officials can make riverbank protection design (comparison and selection of work method, outline design, deitailed design, preparation of drainwgs).] ▪ They are quite all right; score 100 ▪ They can do without help about half of necessary items; score 75 ▪ They can do with help about all of necessary items; score 50 ▪ They can not do even with help about half of necessary items; score 25 ▪ They can not do at all; score 0 (Unidentified matters shall be presumed by results of baseline evaluation.)	▪ Routine discussion, etc. ▪ Output of design work ▪ Responses during the on-the-job training (CV shall be referred to for baseline evaluations)

5. Ability in River Survey	[C/P officials can do topographic survey, bathymetric survey and riverbed material survey, etc.] ▪ They are quite all right; score 100 ▪ They can do without help about half of necessary items; score 75 ▪ They can do with help about all of necessary items; score 50 ▪ They can not do even with help about half of necessary items; score 25 ▪ They can not do at all; score 0 (Unidentified matters shall be presumed by results of baseline evaluation.)	▪ Routine discussion, etc. ▪ Output of survey work, etc. ▪ Responses during the on-the-job training (CV shall be referred to for baseline evaluations)
6. Ability in Monitoring	[C/P officials can understand necessity and execute with proper planning.] ▪ They are quite all right; score 100 ▪ They can do without help about half of necessary items; score 75 ▪ They can do with help about all of necessary items; score 50 ▪ They can not do even with help about half of necessary items; score 25 ▪ They can not do at all; score 0 (Unidentified matters shall be presumed by results of baseline evaluation.)	▪ Routine discussion, etc. ▪ Short test, short paper, interviews ▪ Output of planning and execution of monitoring (CV shall be referred to for baseline evaluations)
7. Ability in Maintenance	[C/P officials can do planning of an emergency measure, execution of measure, and restoration plan, survey, design and construction.] ▪ They are quite all right; score 100 ▪ They can do without help about half of necessary items; score 75 ▪ They can do with help about all of necessary items; score 50 ▪ They can not do even with help about half of necessary items; score 25 ▪ They can not do at all; score 0 (Unidentified matters shall be presumed by results of baseline evaluation.)	▪ Routine discussion, etc. ▪ Short test, short paper, interviews ▪ Result of maintenance plan, execution of measure, restoration plan, survey, design and construction (CV shall be referred to for baseline evaluations)
8. Ability in Construction Supervision	[C/P officials can do construction supervision (preparation of bidding documents, market survey, cost estimation, documentation related to construction, inspection and supervision of construction works).] ▪ They are quite all right; score 100 ▪ They can do without help about half of necessary items; score 75 ▪ They can do with help about all of necessary items; score 50 ▪ They can not do even with help about half of necessary items; score 25 ▪ They can not do at all; score 0 (Unidentified matters shall be presumed by results of baseline evaluation.)	▪ Routine discussion, etc. ▪ Output of construction supervision ▪ Responses at the construction site ▪ Responses during the on-the-job training

Short tests and short papers were performed at appropriate time as supplements of evaluation to mitigate possible subjectivity in the evaluation process.

3.2.2 Baseline Evaluation

As described in Table 2.3-1 in Chapter 2, one (1) C/P official has been replaced in May 2012 and one (1) C/P official has been reassigned in December 2012; however, the target period of baseline evaluation except the ability in construction supervision was set as the term from November 2010 to February 2011. Target period of baseline evaluation for the ability in construction supervision was set as the term from November 2011 to February 2012.

The results of baseline evaluation executed to C/P officials of MPWT and C/P officials of DPWT of Vientiane Capital and three (3) target provinces according to the evaluation criteria for level of understanding are shown in Table 3.2-2 (a), (b), respectively.

Table 3.2-2 (a) Baseline Evaluation Results (MPWT)

Required Abilities	Baseline Evaluation	Routine Discussion, etc.	Short Test, Short Paper, Interviews	Surveys in Surrounding Provinces	Work Products	Remarks
1. Participating attitude to the Project	20	20	—	—	—	▪ There are some C/P officials who don't come to the project office.
2. Basic knowledge on hydrology, hydraulics, and river engineering	17.5	Unexcuted except for one official	C/P doesn't have enough knowledge of technical terms.	—	—	▪ Stages of basic knowledge were presumed by CV.
3. On-site practical abilities	10	Unexcuted	Unexcuted	Unexcuted	—	▪ Stages of basic knowledge for practical abilities were presumed by CV.
Required Abilities	**Baseline Evaluation**	**Routine Discussion, etc.**	**Short Test, Short Paper, Interviews**	**Responses during the OJT**	**Work Products**	**Remarks**
4. Ability in Design	5	Unexcuted	Unexcuted	—	Unexcuted	▪ Almost all are unexperienced.
5. Ability in River Survey	10	Unexcuted	—	—	Unexcuted	▪ Experience of River Surveys were presumed by CV.
6. Ability in Monitoring	5	Unexcuted	Unexcuted	—	Unexcuted	▪ Almost all are unexperienced.
7. Ability in Maintenance	5	Unexcuted	Unexcuted	—	Unexcuted	▪ Almost all are unexperienced.
Required Abilities	**Baseline Evaluation**	**Routine Discussion, etc.**	**Responses at the Construction Site**	**Responses during the OJT**	**Work Products**	**Remarks**
8. Ability in Construction Supervision*	47.5	Excuted	Unexcuted	Unexcuted	Eexcuted	▪ Experienced and unexperienced are mixed.

* Target period of baseline evaluation for the ability in construction supervision was set as the term from November 2011 to February 2012.

Table 3.2-2 (b) Baseline Evaluation Results (DPWT)

Required Abilities	Baseline Evaluation	Routine Discussion, etc.	Short Test, Short Paper, Interviews	Surveys in Surrounding Provinces	Work Products	Remarks
1. Participating attitude to the Project	20	20	—	—	—	▪ C/P can carry out a site explanation under instruction by PM.
2. Basic knowledge on hydrology, hydraulics, and river engineering	10	Unexcuted	C/P doesn't have enough knowledge of technical terms.	—	—	▪ Stages of basic knowledge were presumed by CV.
3. On-site practical abilities	10	Unexcuted	Unexcuted	Unexcuted	—	▪ Stages of basic knowledge for practical abilities were presumed by CV.
Required Abilities	**Baseline Evaluation**	**Routine Discussion, etc.**	**Short Test, Short Paper, Interviews**	**Responses during the OJT**	**Work Products**	**Remarks**
4. Ability in Design	10	Unexcuted	Unexcuted	—	Unexcuted	▪ Almost all are unexperienced.
5. Ability in River Survey	25	Unexcuted	—	—	Unexcuted	▪ Experience of River Surveys were presumed by CV.
6. Ability in Monitoring	0	Unexcuted	Unexcuted	—	Unexcuted	▪ Almost all are unexperienced.
7. Ability in Maintenance	5	Unexcuted	Unexcuted	—	Unexcuted	▪ Almost all are unexperienced.
Required Abilities	**Baseline Evaluation**	**Routine Discussion, etc.**	**Responses at the Construction Site**	**Responses during the OJT**	**Work Products**	**Remarks**
8. Ability in Construction Supervision*	37.5	Excuted	Unexcuted	Unexcuted	Eexcuted	▪ Experienced and unexperienced are mixed.

* Target period of baseline evaluation for the ability in construction supervision was set as the term from November 2011 to February 2012.

3.3 Survey and Planning for Riverbank Protection Works [Output 1]

3.3.1 Ability Improvement through the Implementation of Pilot Projects

(1) Surveying the current situation of river bank erosion in Bokeo Province, Luangprabang Province, and Bolikhamxay Province

Current situation of riverbank erosion was surveyed at the main stream and tributaries of Mekong River in three provinces where the pilot projects were to be conducted mainly through field survey. Prior to the field survey, survey sections were carefully selected by hearing investigation and studying the existing materials such as topographic maps, drawings for existing bank protection construction works, results of geological survey (soil surveying), aerial photographs (satellite images), related facility plans, etc. in order to survey effectively.

Field survey was conducted jointly by JICA expert team and C/P officials. Hearing investigation to the related institution and local residents as appropriate was performed combining with the training on simplified soil test and sampling of riverbed materials (simplified grain size measurement).

Photo 3.3-1 On-site Training to C/P Officials (Simplified Soil Test)

Photo 3.3-2 On-site Training to C/P Officials (Simplified Grain Size Measurement)

(2) Selecting one pilot project site in each province

Based on the survey results of riverbank erosion situation as shown in (1), priority sites for pilot project implementation were studied considering the effectiveness of riverbank protection work in each candidate site, difficulty level of construction works including accessibility to sites, land use of hinterland and environmental impacts. Site selection was made by scoring each candidate site according to the following items with the points based on the result of discussion with C/P officials.

Technical Viability

(a) Riverbank erosion situation

3 Point: Severely eroded in wide area

2 Point: Severely eroded, but partly

1 Point: Eroded

(b) Difficulty level of countermeasure

3 Point: Reasonable countermeasure can be applied

1 Point: Possible but modern work is the only way

0 Point: Countermeasure is difficult

(c) Accessibility

3 Point: Easy to access from the road, close to provincial center

2 Point: Easy to access from the road, but far from provincial center

1 Point: Site is located far from the road

Impact

(d) Land use of hinterland

3 Point: Important facility (Temple, School, etc.) and/or many houses are located

2 Point: Several houses and/or wide farmland are located

1 Point: Few houses and/or narrow farmland are located

0 Point: Hinterland is not utilized

(e) Environmental aspect

3 Point: No constraint for construction, Precious fauna and flora is not identified

1 Point: No constraint for construction, but some treatment is necessary for Environment

0 Point: Site is located in protected area

(f) Others

1) Bokeo Province

Firstly, Bokeo Province where detail design was proposed to be implemented from April 2011 onward was selected as a pilot project site by considering some sections at Ban Paoy have higher priorities comparing other sections, based on the results of above criteria as shown in Table 3.3-1. This was agreed among three parties of DoW, DPWT of Bokeo Province, and JICA expert team on March 21, 2011.

Table 3.3-1 Result of Site Selection for Pilot Project in Bokeo Province

	(a) Erosion Situation	(b) Difficulty Level of Measures	(c) Accessibility	(d) Land Use	(e) Environmental Aspect	(f) Others	Total Score
Lao-Myanmar Border	--- Not Confirm	--- Not Confirm	1	--- Not Confirm	--- Not Confirm	JICA Expert can't Approach	---
Golden Triangle	Project On Going	Project On Going	2	3	3	Project On Going	---
B. Tonpheung	Project Almost Finished	Project Almost Finished	2	3	3	Project Almost Finished	---
B. Homnyen	3	3	2	2	3	Under Budget Request	(13)
B. Simouanggam	Project On Going	Project On Going	2	2	3	Project On Going	---
B. Si Donkun	3	3	2	2	3	Under Budget Request	(13)
B. Si Donnyeng	3	3	2	2	3	Under Budget Request	(13)
B. Doi Deng	Project On Going	Project On Going	2	2	3	Project On Going	---
B. Nam Thouam	1	3	3	3	3	Countermeasure is Expected	13
B. Paoy	2	3	3	3	3	Countermeasure is Expected	14

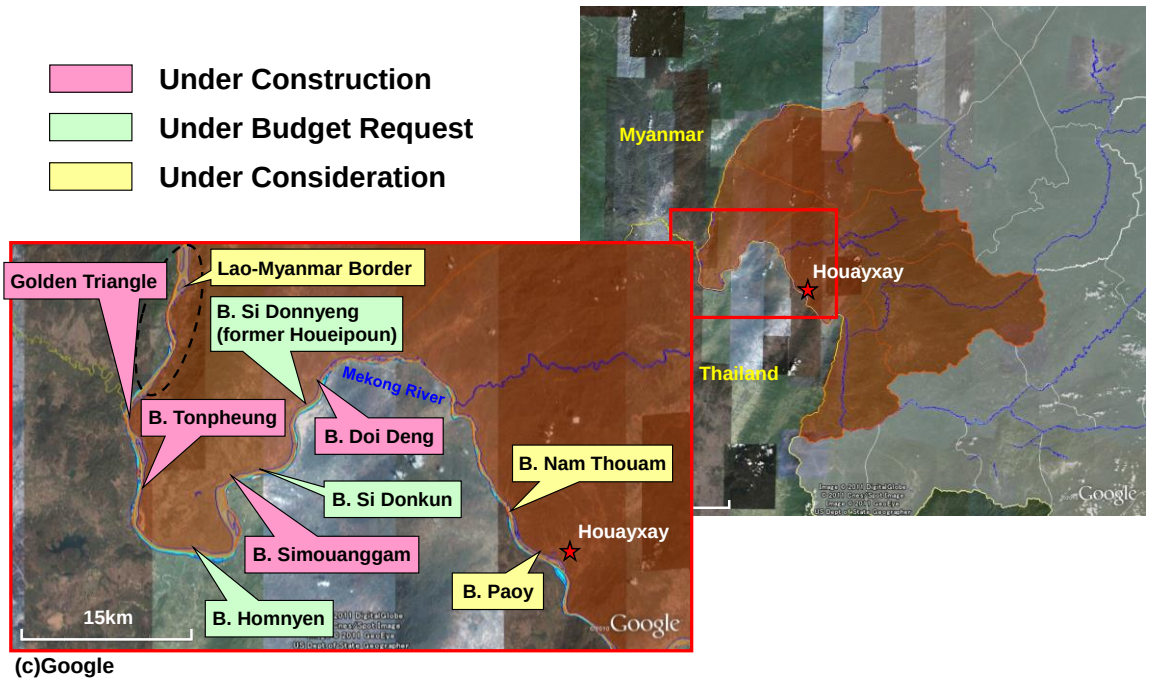


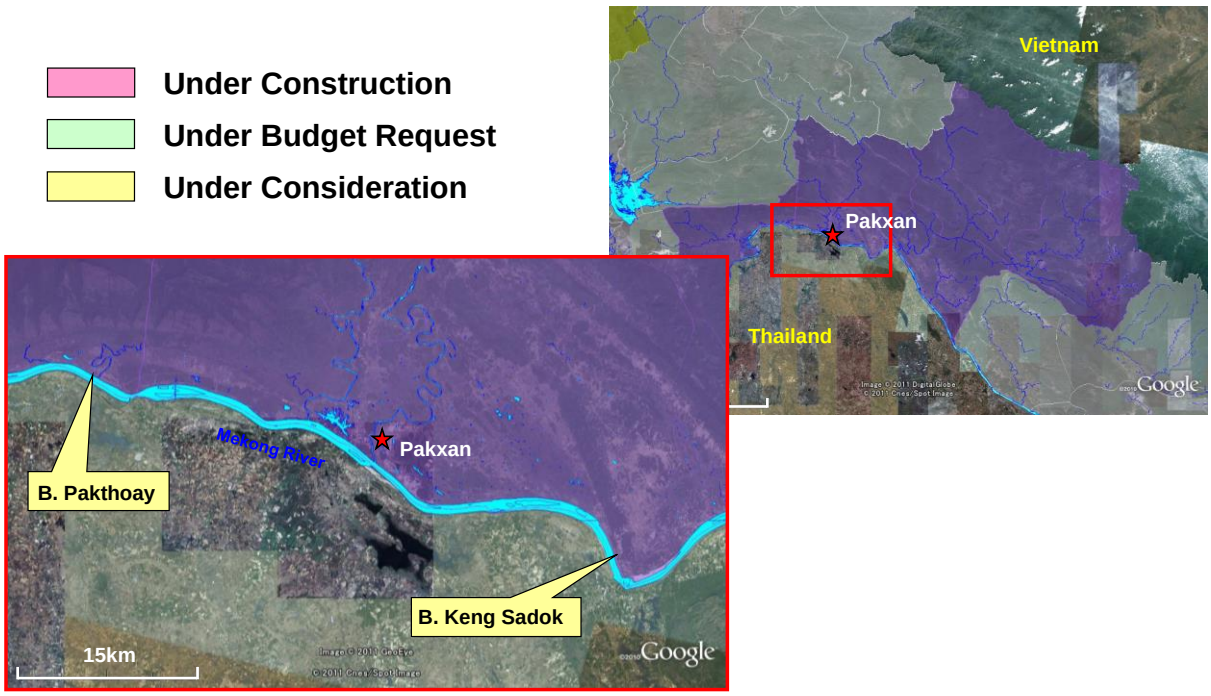
Fig. 3.3-1 Location of Candidate Sites for Pilot Project in Bokeo Province

2) Bolikhamxay Province

Secondly, Bolikhamxay Province was proposed to be implemented as the second pilot project site in 2012. At on-site kick-off meeting (November 26, 2010), Director General of DoW requested two candidate sites of Ban Pakthoay and Ban Keng Sadok to be included into target project sites, and cost to be shared between Japan and Lao P.D.R in 50 to 50 for which Lao side would cover a half of expense required for implementation of these two sites. This would be examined continuously due to the difficulty in prioritization between two sites including technology required (refer to Table 3.3-2 (a)).

Table 3.3-2 (a) Result of Site Selection for Pilot Project in Bolikhamxay Province

	(a) Erosion Situation	(b) Difficulty Level of Measures	(c) Accessibility	(d) Land Use	(e) Environmental Aspect	(f) Others	Total Score
B. Pakthoay	3	3	3	3	3	Countermeasure is Expected	15
B. Keng Sadok	3	3	3	3	3	Countermeasure is Expected	15



(c)Google

Fig. 3.3-2 Location of Candidate Sites for Pilot Project in Bolikhamxay Province

Threrefore the confirmation studies on the pilot project site in Bolikhamxay Province including other four (4) candidate sites than the said two (2) sites through one rainy (flood) season were implemented from November 28 to December 5, 2011.

Surveys on the riverbank erosion state in Mekong River based on the survey and planning manual were implemented by the C/P officials to enhance their initiative.

Studied sites and their evaluation score are shown in Table 3.3-2 (b). Based on the result, Pakthoay village was selected as a pilot construction site for Bolikhamxay Province.

Table 3.3-2 (b) Result of Site Selection for Pilot Project in Bolikhamxay Province [Confirmation]

	(a) Erosion Situation	(b) Difficulty Level of Measures	(c) Accessibility	(d) Land Use	(e) Environmental Aspect	(f) Others	Total Score
B.Pakkading	2	3	3	3	3		14
B.Paknamsa	2	3	3	2	3		13
B.Kengsadok	3	1	3	3	3	Wide region should be protected, Influence of groundwater should be considered.	13
Pakxantai Temple	2	3	3	3	3	Temple is located behind road.	14
Pakxan Hospital	2	3	3	3	3	Hospital is located behind road.	14
B.Pakthoay	3	3	3	3	3	Temple is in urgent situation.	15

3) Luangprabang Province

Finally, Luangprabang Province was proposed to be implemented as the third pilot project site in the beginning of 2013. It was confirmed that new sections of riverbank erosion occurred at candidate sites of Ban Nasa and Ban Moat. This collapse of riverbank itself was not caused by erosion, although riverbank erosion might be a trigger of collapse. The main cause of collapse was considered as a result of landslide caused by the ground water running between clay layer and gravel layer. Especially upper edge of section collapsed at Ban Moat reached very close to National Road #13, and required emergency countermeasure. Director General of DoW had visited the site in November 2010 and had applied budget for rehabilitation. At on-site kick-off meeting in Luangprabang Province (December 6, 2010), Mr. Fasananh THOMMAVONG, Director General of DPWT Luangprabang Province requested for advice from Japanese experts in regards to the possibility of earlier implementation of Ban Moat before proposed implementation schedule of 2013 as pilot project construction. In the end of February 2011, two experts conducted additional survey of Ban Moat and provided suggestions and recommendation for executing counter measures. Ban Moat site required for emergency measure, has been excluded from candidate sites, provided that

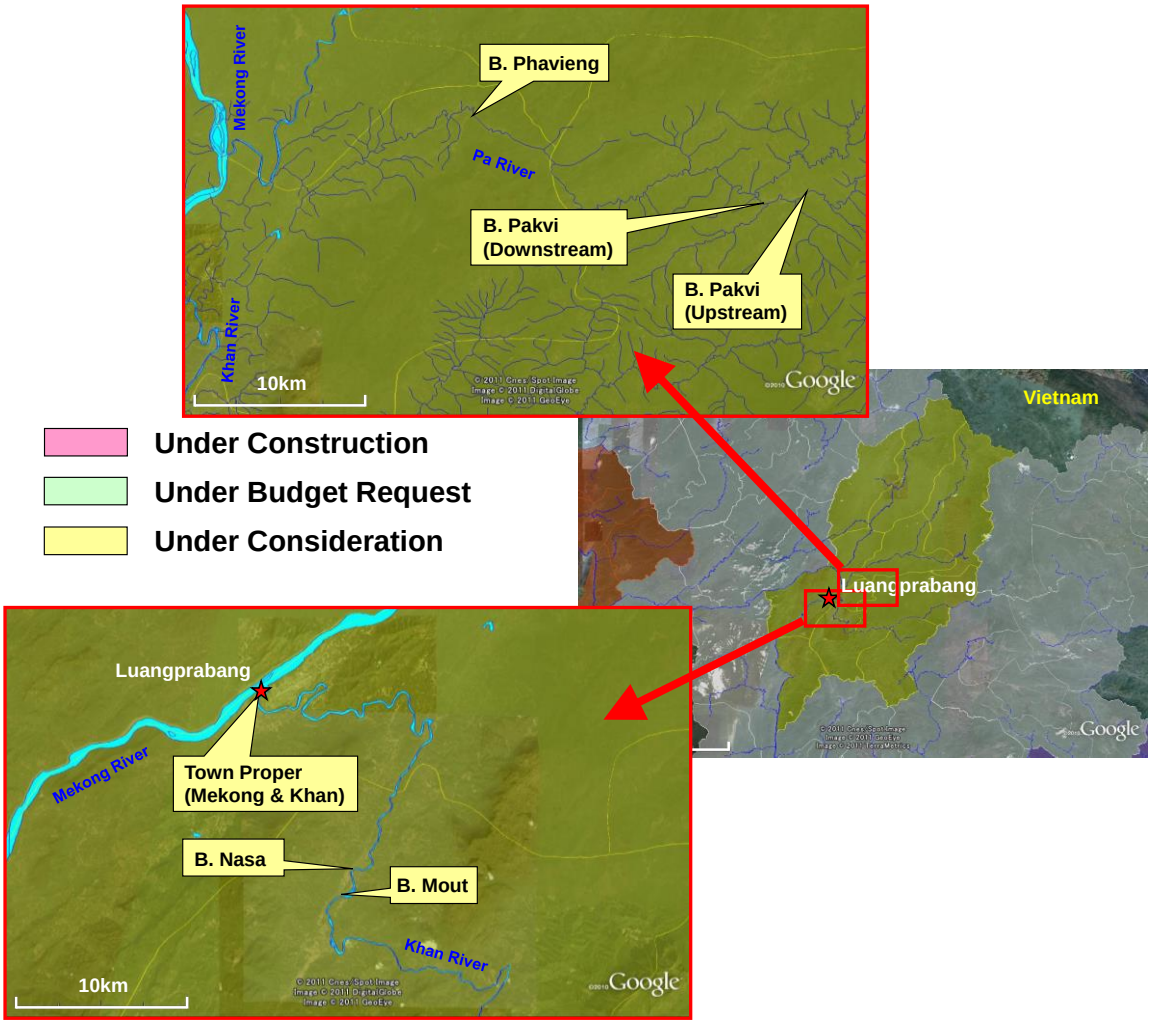
examination of site selections for Luangprabang Province would be continued (refer to Table 3.3-3 (a)).

Table 3.3-3 (a) Result of Site Selection for Pilot Project in Luangprabang Province

	(a) Erosion Situation	(b) Difficulty Level of Measures	(c) Accessibility	(d) Land Use	(e) Environmental Aspect	(f) Others	Total Score
Town Proper (Mekong River Side)	1	3	3	3	0	Countermeasure is Expected	10
Town Proper (Khan River Side)	1	3	3	3	0	Countermeasure is Expected	10
B. Nasa	2	3	3	3	3	Countermeasure is Expected	14
B. Moat	2	3	3	3	3	Countermeasure is Expected	14
B. Phavieng	1	3	2	3	3	Countermeasure is Expected	12
B. Pakvi (Upstream)	1	3	2	2	3	Countermeasure is Expected	11
B. Pakvi (Downstream)	1	3	2	1	3	Countermeasure is Expected	10

Threrefore the confirmation studies on the pilot project site in Luangprabang Province over the two (2) rainy (flood) seasons were done based on the survey/planning manual from December 12 to December 14, 2012 by the C/P officials to enhance their initiative.

Studied sites and their evaluation scores are shown in Table 3.3-3 (b). Based on the result, Ban Souanlouang (Ban Nasa) was selected as a pilot construction site for Luangprabang Province.



(c)Google

Fig. 3.3-3 Location of Candidate Sites for Pilot Project in Luangprabang Province

Table 3.3-3 (b) Result of Site Selection for Pilot Project in Luangprabang Province [Confirmation]

	(a) Erosion Situation	(b) Difficulty Level of Measures	(c) Accessibility	(d) Land Use	(e) Environmental Aspect	(f) Others	Total Score
Hoay Hope	2	3	2	3	3		13
Pak Hoay	3	2	3	3	2		13
Hoay Mao	3	3	2	3	3		14
Hoay Phee Lok	2	3	2	3	3		13
B. Souanlouang	3	3	3	3	3	Damaged by floods	15
B. Mout	3	3	3	2	3	Damaged by floods	14

(3) Selecting low-cost and environmental-friendly riverbank protection work to be applied to each site

Concept of Selecting Types of Works: In this Project (Phase II), the basic idea of selecting types of work methods is that riverbank protection work type is to be so selected to realize the followings as much as possible:

i) Using local construction material as much as possible.

ii) Using manpower of Lao P.D.R. as much as possible.

iii) To pay attention to keep riverine environment

iv) Construction cost (as lower as practicable)

Coping Measures to Erosion: Bank protection works mainly consist of the following component works in general:

(1) Foot Protection Works: To protect the foundation and slope pavement from the riverbed scour, flexibly adjusting to the riverbed changes.

(2) Foundation Works: To support slope pavement works, firmly fixing the foot of slope.

(3) Slope Protection Works: To protect slope by covering the slope surface.

Procedure of Selecting Types of works: Riverbank protection work was selected according to the following two steps as first screening and second screening.

1) 1st screening

Several riverbank protection works were chosen among various riverbank protection works, inclusive of not only traditional Japanese river works, but recent riverbank works using concrete material as shown in Table 3.3-4.

Riverbank protection works to be selected should be of adoptable ones to the candidate site to be protected. The selected riverbank protection works shall be firstly obtained as two (2) to three (3) candidate work methods among various riverbank protection works for second screening in consideration of such riverbank conditions as work length, slope inclination, erosion situation, etc.

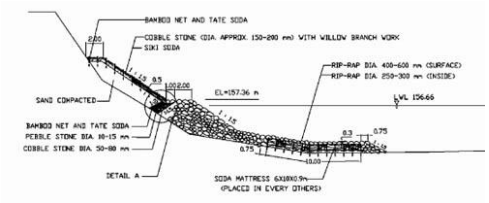
2) 2nd screening

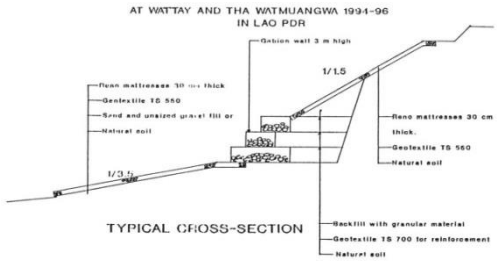
Selected candidate riverbank protection works in the first screening were compared and evaluated in terms of strength, life time, easiness of material procurement, stability/flexibility, construction technique, construction cost, riverine environment/landscape, and ecology.

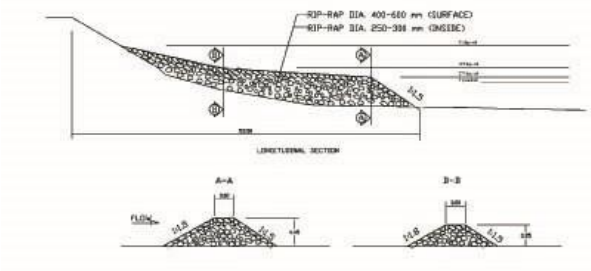
Table 3.3-5 and Table 3.3-6 show examples of results of first and second screening executed for Paoy site in Bokeo province as a Pilot Project.

As a result, "Soda Mattress + Cobble Stone with Soda Work + Rip-rap Foundation Work" was regarded as the best among others for Paoy site (1) and Rip-rap Groyne Work as the best for Paoy site (2) and (3).

Table 3.3-4 Composition of Riverbank Protection Work Methods

No	Work Method	Features	Photo	Construction material	Remark
1	Cobble stone with Soda Works + Soda Mattress + Rip-rap foundation	This method consists of Siki-Soda on the slope of earth embankment, tie-twig hurdle work on them, made of willow branch, covered by pebble stone and sand with willow plantation on them. Rip-rap work is a foundation of the slopes to support the upper structure to avoid any failure of the slope. Surface riprap is to protect the foundation against river flood, and inner one is placed to avoid soil and gravel flushing out due to backpressure. Soda Mattress consists of Soda (facine), Rensai (bunch of facine), Siki-Soda (facine flooring), Sigara (hurdle work), and Chinseki (rubble stone). On the lower lattice structure of Rensai with grid 	   	Soda (Brush wood), Wooden short pile, stone	Construction cost: About 810 ～1,690 US$/m, Suitable for mild slope river, not for rapid flow river

No	Work Method	Features	Photo	Construction material	Remark
2	Pitched stone in concrete frames + riprap foundation work	**Pitched stone** is so placed as to form flat surface in **concrete frame work** on embanked riverbank with mild slope of about 1 : 3. Stone size of about 200 – 400 mm in diameter is used. Stone layer thickness is about 0.5 m. Concrete step and drain culvert made of concrete are built in the slope perpendicular to the river. Width of slope is about 30m. Foundation work of **rip-rap stone work** supports the slope protection work above. Shoulder work of about 1 m wide is set for sidewalk and a line of drainage culver beneath it. Rigid structure is strong against fast flow velocity, but once damaged easy to collapse.	 	Concrete, Stone, geotextile	About 2,800 US$/m (Thailand)
3	Reno Mattress + Gabion Mattress	River bank is covered by combination of **Reno Mattress and Gabion basket** as shown below. Lower part at the edge is connected to natural riverbank. Iron basket could gradually deteriorate in long years. 	 	Reno Mattress, Gabion basket, stone, geo-textile	About 1,920 US$/m as of 1995-1996 (Wattay and Tha Wat Muangwa)

No	Work Method	Features	Photo	Construction material	Remark
4	Rip-rap Groyne	Groyne work is to protect riverbanks from the direct attack of the river flow by reducing the flow velocity and changing the flow direction. Function of the groyne is; 1) Reducing the flow velocity by increasing resistance to the flow (flow velocity reduction action), 2) Blocking the flowing water to change its direction so that it does not impact the location that should be protected. 	 	Stone, crushed stone	About 600～1,800 US$/m Riverbank between groynes could be vulnerable in high water period. Tip of gryone might be weak against fast river current.
5.	Wooden Pile Dike Groyne	Typical permeable dyke groyne made of wooden piles spaced in every 1.0～1.2m each other and arranged in more than two rows. Piles are tightened by wooden board laterally and longitudinally or diagonally to connect each pile. This work is usually applied in mild slope river. For steep slope river also protected, where piles can be driven into the riverbed with sufficient depth of embedment. Although less construction cost, necessary attention to the conservation of forest with respect to environmental aspect should be paid. Sometimes Soda mattress is placed around the gryone against possible erosion.	 	Wood	About 200 US$/m Suitable for river with sandy riverbed, not suitable for gravel/stone riverbed.

No	Work Method	Features	Photo	Construction material	Remark
6.	Wooden Pile Hurdle work	Log hurdle work as foundation work is composed of primary log piling, secondary (short) piling, connecting beak and cobbles placed behind log hurdles as back-fill. Primary log piling is set at interval of 2m and secondary pilings are at interval of 20cm between primary logs. Connecting beam by bolts connects primary log and secondary log.	 	Wood: hard enough against external force and deterioration	.
7.	Rensai Hurdle work	Rensai hurdle work is composed of wooden pile of dia.12m placed at interval of 0.6m～1.0 m and Rensai connected to them by rope/iron string and filled with crushed stone behind.		Wooden pile, Rensai, rope, iron string, crushed stone	
8.	Soda Hurdle work	Soda hurdle work is composed of Short pile of diameter about 9 cm at foot placed at interval of about 60 cm and weaved by Taisha (flexible Soda) between the piles. Crushed stone is filled behind after placing Tate-Soda in between.		Soda, Taisha, wooden short pile, crushed stone	
9.	Rensai culvert	Along the channel side wall, Soda hurdle work is placed to stabilize the wall and Soda is floored at the bottom of the channel. While Rensai is placed in the channel after setting Tate-soda between Soda hurdle work and Rensai. The work is embedded by covering soil and gravel and covered with crushed stone on the surface.		Wooden pile, Rensai, rope, iron string, crushed stone	

Table 3.3-5 First Screening of Riverbank Protection Work Method at Paoy Site

Item	Location	
	Paoy site (1)	Paoy site (2) and (3)
Length of river bank to be protected	200m	500m and 300m
Conditions of river bank slope	Riverbank of about 35° slope consists of fine sand layer on the lower gravel layer. Upper part of the slope is covered with grasses and lower is naked. Notches around upper part of gravel layer scatter.	Riverbank of about 35° slope is covered with grasses at upper part, but lower part of the bank is without vegetation and extends into Mekong river water.
Type of erosion	Falling of slope material as block undermined through lower layer of gravel and silt forming notches at the foot of slope during flood period.	Erosion type is the same as site (1).
Hinterland use	Agricultural farm land, grass land and some resident houses, restaurants scattered. Provincial road runs along the river.	Thai funded factory between (2) and (3) exists and manages riverbank protection by themselves.
Point to be emphasized as bank protection measure.	To protect the lower gravel and upper find sand layer	Same as site (1)
Major bank protection work type	Foot protection work and lower part of slope protection	Lower part of the riverbank is to be protected.
Candidate type of protection works	1) Soda mattress as foot protections and cobble stone with willow branch work for the slope protection and rip-rap foundation work	1) Soda mattress as foot protections and cobble stone with willow branch work for the slope protection and rip-rap foundation work
	2) Pitched stone in concrete frame on the rip-rap foundation work	2) Rip-rap groyne work
	3) Reno mattress and gabion basket work	3) Reno mattress and gabion basket work

Table 3.3-6 Second Screening of Riverbank Protection Work Method at Paoy Site

Site Name	Type of Construction Work	Strength	Life time	Stability/ Flexibility	Matterial retreiving	Construction Technic	Construction Cost	Riverine engironment/ Landcape	Ecological view	Priority
Paoy (1)	1) Soda mattress as foot protections and cobble stone with willow branch work for the slope protection and rip-rap foundation work	○	◎	◎	○	△	○	○	◎	1
	2) Pitched stone in concrete frame on the rip-rap foundation work	◎	○	△	○	△	△	○	○	3
	3) Reno mattress and gabion basket work	○	△	○	△	○	△	○	○	2
Paoy (2), (3)	1) Soda mattress as foot protections and cobble stone with willow branch work for the slope protection and rip-rap foundation work	○	◎	◎	○	△	○	○	◎	2
	2) Rip-rap groyne work	○	◎	○	○	◎	◎	○	○	1
	3) Reno mattress and gabion basket work	○	△	○	△	○	△	○	○	3

3.3.2 Ability Improvement through Developing and Updating Manuals

(1) Manual for survey and planning on riverbank protection works

C/P officials took a main role to develop manuals based on their experiences in the pilot project sites, which will lead to help Lao P.D.R. conduct subsequent research and planning of riverbank protection work on their own after completion of the projects. Utilizing the planning and design manuals prepared for Development Study, it was aimed to develop practical and user-friendly manuals based on their experiences in research regarding pilot project sites and site selection.

The manual was intended to be clear and simple guideline for types of riverbank protection works, their functions, research items/focus points/methods at planning, how to organize research results, points of attention to evaluation, how to determine work method, its specifications and scope, etc. Also, various survey works conducted for design of riverbank protection work (refer to 3.4.2) were described in this "survey and planning" manual.

Originally this manual was scheduled to be updated and finalized in the first year (refer to Fig. 1.7-2 and Table 2.1-1), however, not only the results of examination for the pilot project in Bokeo Province (in the first year) but also those of examinations for the pilot projects in both Bolikhamxay Province (in the second year) and Luangprabang Province (in the third year) were reflected in this manual for further comprehensive improvement (refer to Table 2.1-3).

Final edition of the manual which was translated into Lao by C/P officials with the cooperation of professors of National University of Laos (NUOL) is attached to annex of this report.

(2) Maintenance manual on survey equipment for riverbank protection works

Maintenance manual of equipment and tools, which were donated by JICA for the survey, was prepared in the first year by C/P officials in collaboration with JICA experts. Lists of equipment were reviewed for Phase I and Development Study for maintenance work. Procedure of maintenance of the equipment was tabulated including checking item for each equipment and necessity of taking photographs. Schedule of maintenance work was also revealed.

Final edition of the manual, attached to annex of this report, is described in English, because user of this manual will be C/P officials who belong to DoW, MPWT only.

3.3.3 Improve Organizational Ability through Training Instructors and Establishing Training System by Providing Trainings and Seminars

First training session and seminar was held on selection procedure for appropriate riverbank protection works based on the survey results of riverbank erosion situation in Bokeo Province, Luangprabang Province and Bolikhamxay Province and comparison of construction methods. Participants were officials from DPWT nationwide including target group. In conjunction with seminars on river engineering and river management as described in 3.6.1, sessions were held for two days from March 2 to 3, 2011 at Vientiane Capital. Related materials regarding seminars and sessions are as shown in Appendix-3.

In total 37 participants attended, who were Mr. Vanthong SOMPHAVATH, Deputy Director General as the head and six (6) officials from DoW, 20 officials from DPWT of local governments (one capital city and 16 provinces), two (2) officials from JICA Laos office and one (1) JICA expert dispatched to MPWT, also one (1) translator and seven (7) JICA experts delegated for the project.

The seminar was held as a part of training to improve ability of C/P officials from the target group. Therefore lecture programs on “Survey and Planning of Riverbank Protection Works” were presented by C/P officials as instructor under the guidance of JICA experts. On the other hand, lecture programs on “River Engineering and River Management” related to 3.6.1 were presented by JICA experts as instructor. In addition, JICA expert in Traditional Riverbank Protection/ Construction Advice demonstrated fabrication of Soda Mattress (fascine mattress), one of the Japanese traditional riverbank protection works.

The main program of the first day was the demonstration of Soda Mattress fabrication, and the second day’s was mainly lectures at MPWT meeting room. After the seminar, a ceremony was held for the handover of equipment procured for the project such as personal computers, portable GPS, total station for topographic survey and so forth. The seminar was closed after taking a ceremonial photograph.

Photo 3.3-3 Explaining the Fabrication Process of Soda Mattress

Photo 3.3-4 Hands-on Training under the Instruction of JICA Expert

Photo 3.3-5 Explaining the Vegetation Establishment Technique by JICA Expert

Photo 3.3-6 Completed 4m × 4m Soda Mattress (Minimum Size)

Photo 3.3-7 A Ceremonial Photograph with Soda Mattress (Left)
(Friendship Bridge on the back)

Photo 3.3-8 Instructors from Lao Side and Japan Side

Photo 3.3-9 The Lecture Scene

Photo 3.3-10 The Handover Ceremony of Equipment Procured for the Project

Photo 3.3-11 A Ceremonial Photograph after the Closing

Originally lecture programs on "Survey and Planning of Riverbank Protection Works" were scheduled to be presented for the first training session and seminar only (refer to Fig. 1.7-2 and Table 2.1-1), however, lecture programs in this field were also presented for the second and third training sessions and seminars as shown in Table 3.3-7 in association with revision of survey and planning manual for further understanding of survey and planning field by C/P officials.

Table 3.3-7 Lecture Programs and Instructors on "Survey and Planning of Riverbank Protection Works"

1st Seminar (Vientiane Capital) March 2, 2011 (Wed), March 3, 2011 (Thu) 37 Participants	The 2nd day: March 3, 2011 (Thu)
	<09:00 – 09:50> Methods of River Bank Protection Works and Their Requirements *Instructor: Mr. Phimmasone SENGSOURIYAVONG, DoW, MPWT* *Supported by Dr. Hideki OTSUKI, Vice Chief Advisor*
	<09:50 – 10:40> Geological and/or Soil Condition of Riverbank and its Countermeasure *Instructor: Mr. Som Ock MANICHANH, DPWT Bokeo Province* *Supported by Mr. Mitsuhiro TOKUSU, Expert on Geological Survey*
	<11:00 – 11:50> Site Selection Procedure and Case Study in Three Provinces <11:00 – 11:10> Situation of riverbank erosion in Bokeo *Mr. Som Ock MANICHANH, DPWT Bokeo Province* <11:10 – 11:20> Situation of riverbank erosion in Bolikhamxay *Mr. Khamphong THEPKHAMHEUANG, DPWT Bolikhamxay Province* <11:20 – 11:30> Situation of riverbank erosion in Lungpharbang *Mr. Sombath CHAREUNPHONE, DPWT Luangprabang Province* <11:30 – 11:50> Site Selection Procedure and Case Study in Three Provinces *Instructor: Mr. Kongmy XAIYASOUK, DoW, MPWT* *Supported by Mr. Taketoshi MATSUNAGA, Chief Adviser*
	<13:20 – 14:10> Selection of Work Method for Selected Sites in Each Province *Instructor: Mr. Anouxay MONGKHOUN, DoW, MPWT* *Supported by Dr. Rokuro KOBAYASHI, Expert on River Engineering/ Riverbank Protection Planning & Design/ Topographic Survey*
2nd Seminar (Bokeo Province) February 2, 2012 (Thu), February 3, 2012 (Fri) 40 Participants	The 1st day: February 2, 2012 (Thu)
	<10:40 – 11:10> Site Selection for Pilot Construction in Bolikhamxay Province *Instructor: Mr. Khamphong THEPKHAMHEUANG, DPWT Bolikhamxay Province*
	<11:10 – 11:30> Site Selection for Khammouane Province *Instructor: Mr. Phimmasone SENGSOURIYAVONG, DoW, MPWT*
	<13:00 – 13:40> Manual on Survey and Planning for Riverbank Protection Works *Instructor: Mr. Khampheiuy LEEFHUNG, DoW, MPWT*
	<15:20 – 16:00> Introduction of Equipment for River Works *Instructor: Mr. Anouxay MONGKHOUN, DoW, MPWT*
3rd Seminar (Bolikhamxay Province) March 28, 2013 (Thu), March 29, 2013 (Fri) 35 Participants	The 1st day: March 28, 2013 (Thu)
	<13:50 – 14:25> Site Selection for Pilot Construction in Luangprabang Province *Instructor: Mr. Sombath CHAREUNPHONH, DPWT Luangprabang Province*
	<14:25 – 14:50> Site Selection for Oudomxay Province *Instructor: Mr. Souksavanh THITHAVONG, DoW, MPWT* *Project Manager of Phase II*

3.3.4 Survey/Planning Activities and Edification/Public Relation by C/P in Provinces Other Than the Target Group's

The study on the riverbank erosion state in other neighboring provinces than the target provinces as well as confirmation studies on the pilot project site (conducted in the second and third year) described in 3.3.1 (2) based on the survey/planning manual were implemented by the C/P officials to enhance their initiative.

Candidate province for the study near Bolikhamxay Province for the acitivity in the second year was discussed by Lao side. As a result, Khammouane Province was selected and Thakhek Nua site and Houynangli site were suggested by DPWT Khammouane Province for the study. The joint study mission was implemented from December 6 to December 9, 2011 by the C/P officials with the participation of some officials in DPWT Khammouane Province.

Based on the study result, Thakhek Nua site was prioritized (refer to Table 3.3-8), and recommended for prioritized site on riverbank protection work for future and approved by Director General of DPWT Khammouane Province.

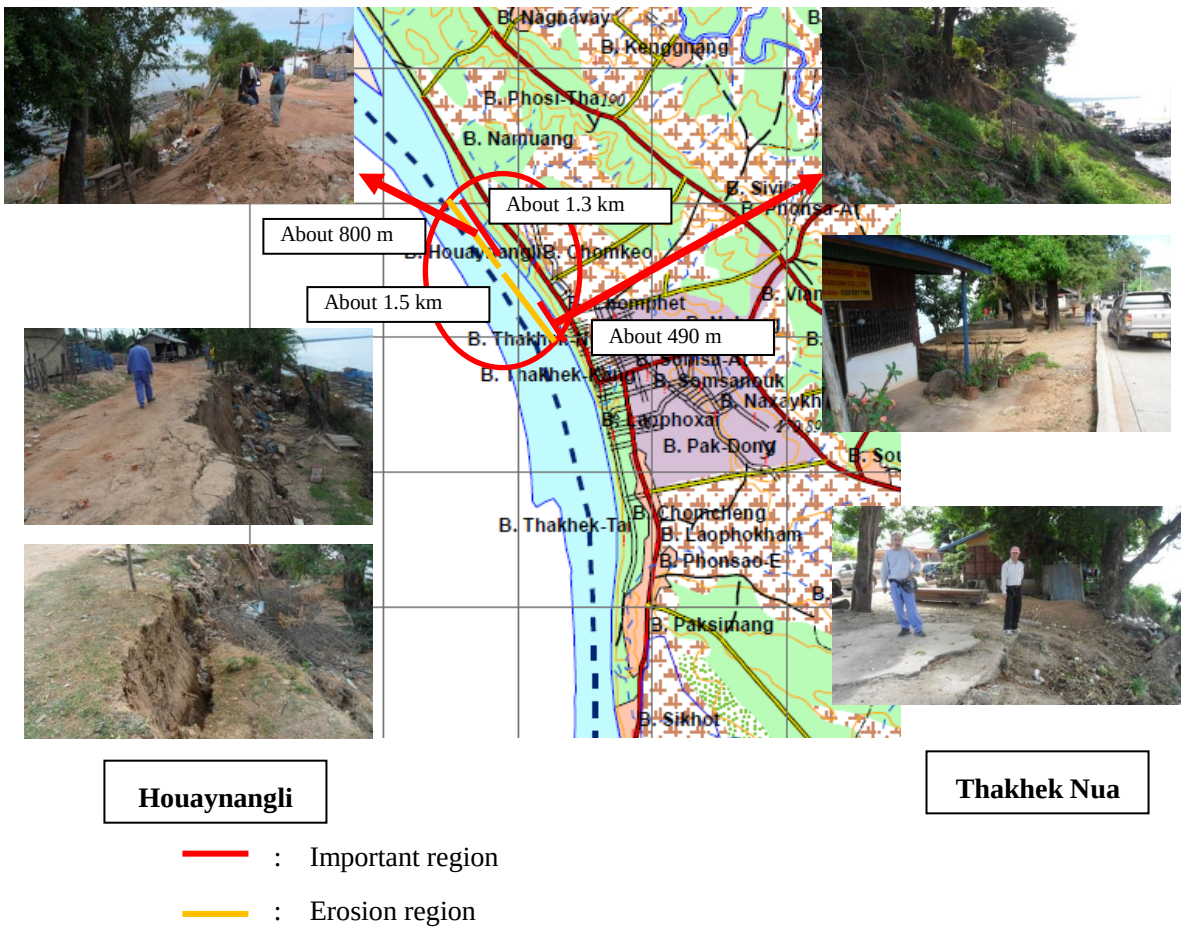


Fig. 3.3-4 Situation of Riverbank Erosion at Thakhek Nua Site and Houynangli Site in Khammouane Province

Table 3.3-8 Result of Site Selection in Khammouane Province for Future Implementation of Riverbank Protction Works

	(a) Erosion Situation	(b) Difficulty Level of Measures	(c) Accessibility	(d) Land Use	(e) Environmental Aspect	(f) Others	Total Score
Thakhek Nua	3	3	3	3	3		15
Houynangli	3	3	2	2	3		13

Also candidate province for the study near Luangprabang Province for the acitivity in the third year was discussed by Lao side. As a result, Oudomxay Province was selected and four (4) sites were suggested by DPWT Oudomxay Province for the study. The joint study mission was implemented from September 11 to September 12, 2012 by the C/P officials with the participation of some officials in DPWT Oudomxay Province.

Based on the study result, Navanhnoy site was prioritized (refer to Table 3.3-9), and Wooden Pile Dike Groyne Work (reinforced by Soda Mattress) which had been adopted for Wat Chom Cheng site in Vientiane Capital in the Development Study (2004), was regarded as the candidate riverbank protection work method for Navanhnoy site with the reasons as shown below:

- Top of riverbank is not high like Mekong River.
- Slope angle is not so steep.
- Easiness of construction.
- Construction cost is relatively low.
- Environmental impact is small (environmentally-friendly).

Finally Navanhnoy site and Wooden Pile Dike Groyne Work (reinforced by Soda Mattress) method were recommended for prioritized site and candidate riverbank protection works for future, respectively, and approved by Director General of DPWT Oudomxay Province.

Table 3.3-9 Result of Site Selection in Oudomxay Province for Future Implementation of Riverbank Protction Works

	(a) Erosion Situation	(b) Difficulty Level of Measures	(c) Accessibility	(d) Land Use	(e) Environmental Aspect	(f) Others	Total Score
B. Navanhnoy	3	3	3	3	3	Houses and Army museum urgent situation	15
B.Nasao	2	3	3	3	3	Houses and Road	14
B. Viengkham	1	1	3	3	3	Houses and hot spring	11
B. Parkkor	1	1	3	3	3	Houses and school	11

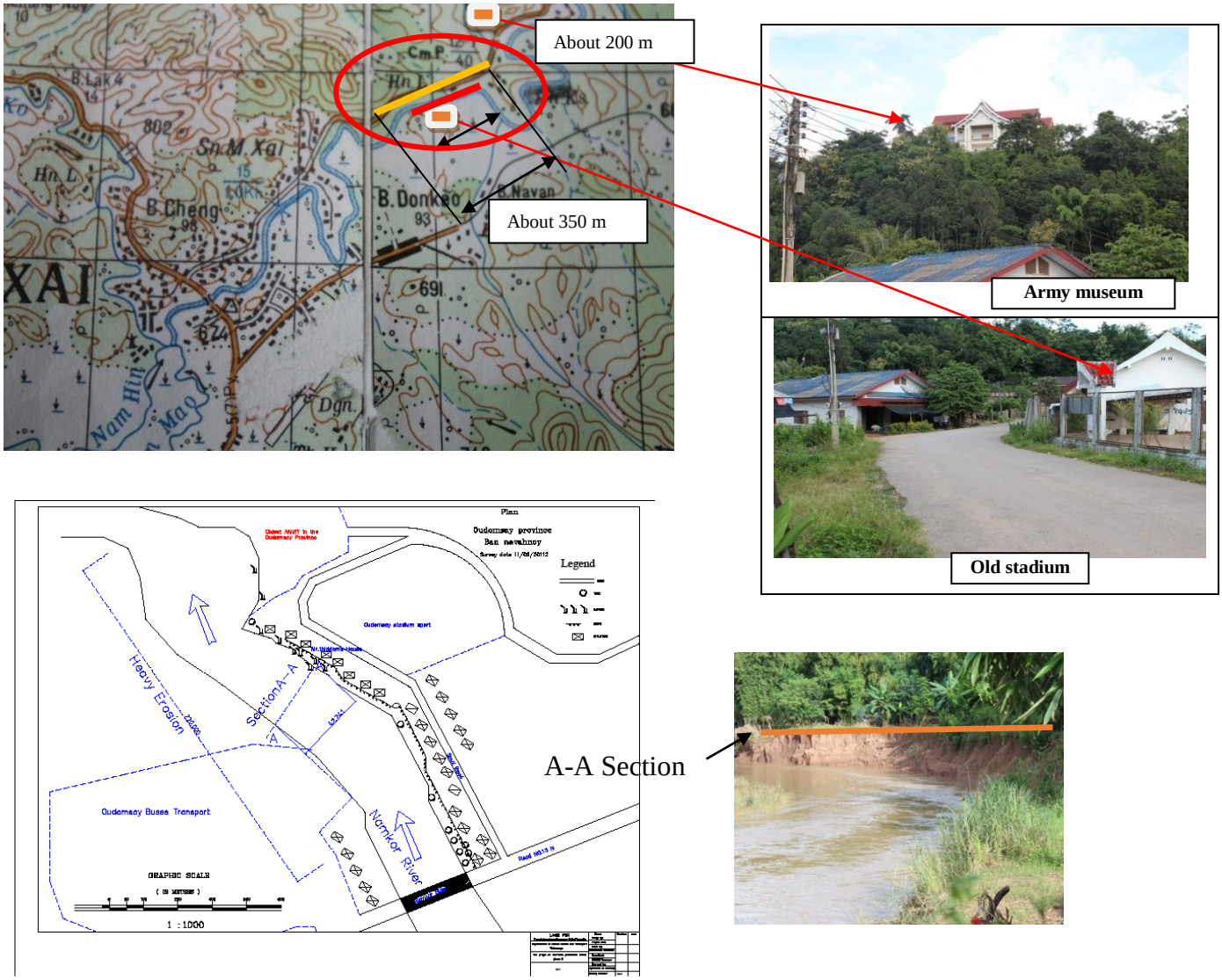


Fig. 3.3-5 Situation of Riverbank Erosion at Navanhnoy Site in Oudomxay Province

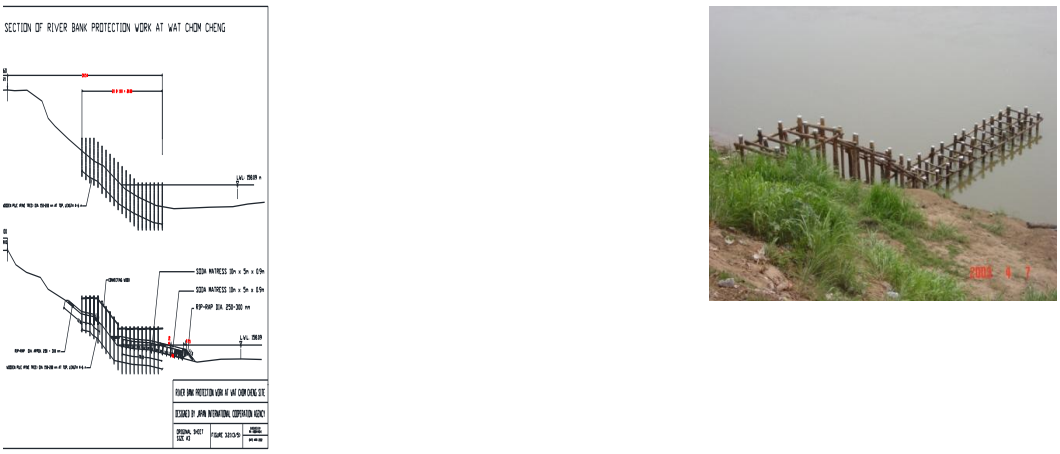


Fig. 3.3-6 Wooden Pile Dike Groyne Work as a Candidate Riverbank Protection Works at Navanhnoy Site in Oudomxay Province (Adopted for Wat Chom Cheng Site in Vientiane Capital)

3.4 Design and Construction for Riverbank Protection Works [Output 2]

3.4.1 Evaluation and Verification of Riverbank Protection Works Conducted in Development Study and Phase I in Vientiane Capital

At six (6) sites in total (two sites there of were design only) along the Mekong River running through Vientiane Capital, riverbank protection works using traditional river works have been implemented as a part of pilot projects in "Development Study" and "Phase I". Some of those riverbank protection works were implemented seven (7) years ago (as of the year 2011), which were the best sample to evaluate and validate robustness of works to determine the need of maintenance. Findings from those sample works would be utilized for design, monitoring, evaluation and maintenance of the pilot projects implemented in this project.

Evaluation and validation was carried out corresponding with the first seminars as descrbed in 3.3.3 on February 28 and March 1, 2011.

In total 20 participants attended, who were Mr. Bounleuane CHANTHACHACK, Director of Riverbank Protection and Flood Control Division as the head and six (6) officials from DoW, seven (7) officials from DPWT of local governments (one capital city and 3 provinces) and seven (7) JICA experts delegated for the project.

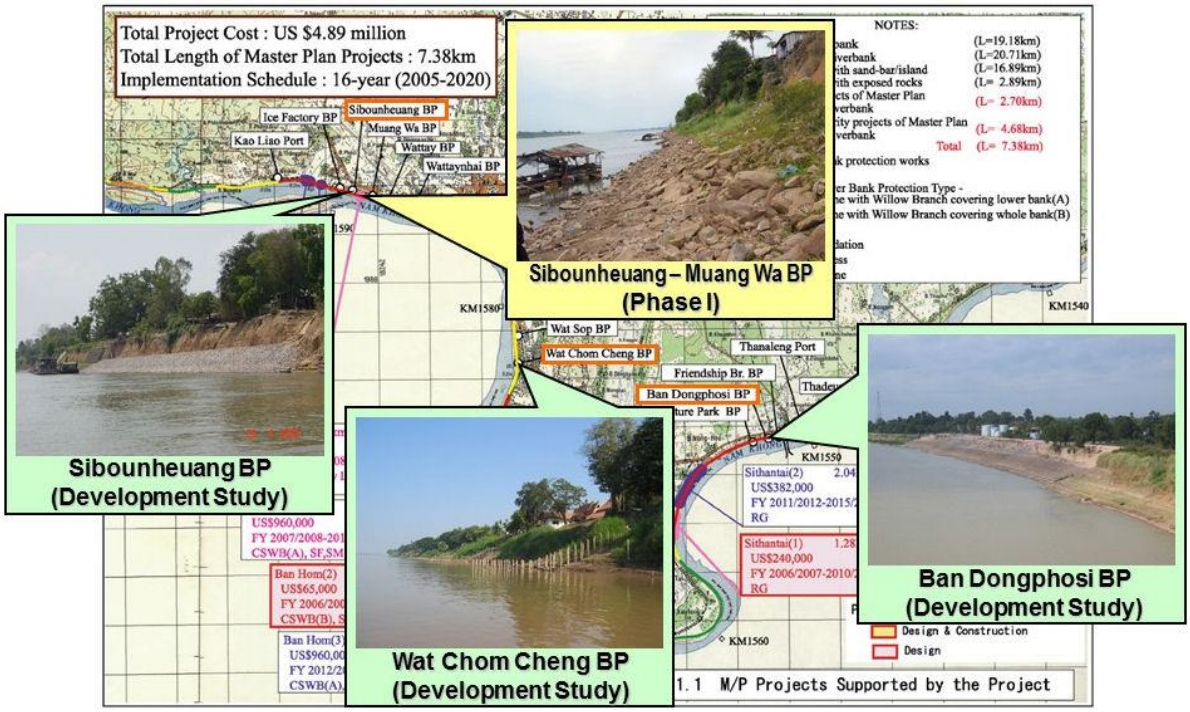


Fig. 3.4-1 Riverbank Protection Works Conducted in Development Study and Phase I in Vientiane Capital

As a result of site reconnaissance to the sites as well as interview to local residents, findings are the

following:

- Riverbank protection works installed at four (4) sites were in good condition and well functioning. Even though small deformation and/or local damage had been occasionally occurred to the structure which has experienced the first rainy (flood) season after completion, necessity of maintenance was almost nothing.
- Sediment deposition was favorable and also vegetation at the slope surface was also flourishing. Therefore some portion was seemed to be a natural riverbank.
- Slope protection work (Cobble Stone with Soda Work) at Sibounheuang site (Development Study) and Sibounheuang - Muang Wa site (Phase I) covering lower half of the cliffy bank for cost reduction was adopted. According to the interviewed local residents along the Sibounheuang site and/or Sibounheuang - Muang Wa site, they were worried about upper half of bared riverbank and preferred to accept riverbank protection works with the slope protection work covering whole of the riverbank.
- However they expressed their appreciation to the installed riverbank protection works because of their peaceful sleep. They used to be botherd the noise when riverbank had been collapsed at night.

Based on the above-mentioned findings, JICA experts and C/P officials realized and agreed that the following items should be be utilized for design, monitoring, evaluation and maintenance of the pilot projects implemented in this project.

- Although the trade-off between cost effectiveness and satisfaction of residents needs, slope protection work covering whole of the riverbank is expected by local residents. Not only technical aspect but also psychological factors are the considerable element to design coverage area of slope protection work.
- Monitoring period for the first rainy (flood) season after completion should be rather paid close attention than further monitoring period after experienced one (1) rainy (flood) season.

3.4.2 Ability Improvement through the Implementation of Pilot Projects

(1) Implementing survey needed for executing the riverbank protection work

Survey was conducted mainly in dry season when water level of the river is low, to make detailed examination of riverbank, riverbed, and geological condition, etc. for determination of cross-section of riverbank protection work. It was aimed to create the following scenario: Tools that were donated to Lao P.D.R. should be utilized, C/P officials should be instructed on how to use those surveying tools, C/P officials took a main role to conduct survey and basic measurements so that they were able to develop planning of facilities according to the results of the survey and basic measurements.

1) Bokeo Province

Survey work for executing the riverbank protection work at Paoy site consists of: a) Survey of cross section of the Mekong River, b) Current survey and c) Water level survey. Those works were conducted mainly by C/P officials with support of JICA expert by using mainly survey equipment

donated by JICA. While topographic survey along Paoy site was conducted by local survey company under the supervision of C/P officials and JICA experts. Scope of each conducted survey work is as shown below:

a) Survey of cross section of the Mekong River

Survey line was approximately right angle to riverbank of the Mekong River at Paoy site with length of approximately 850m up-to riverbank of Thailand side. Topographic survey on land and bathymetric survey in water were conducted.

b) Current survey

Current of Mekong river flow in front of Paoy site was measured by float method. Float was made of bamboo with flag and weight so as to make it upright.

c) Water level survey

Water staff gauges were installed at Paoy site. Daily water level has been recorded by C/P personnel.

d) Topographic survey and bathymetric survey along Paoy site

Survey work was conducted at Paoy site. Scope of survey area is as below.
Site1: Length 200m, Site 2: Length 500m, Site3: Length 300m.
Width of each survey site is approximately 70m in Lao side. On land survey was done using Total Station and bathymetric survey was done by using Echo Sounder. Cross section was drawn in every 20m. Total 50 sections.

2) Bolikhamxay Province

Survey work for executing the riverbank protection work at Pakthoay site in Bolikhamxay Province consisting of: a) Topographic survey and bathymetric survey, b) Current survey, c) Water level survey and d) Survey of cross section of the Mekong River were conducted. Those works were conducted mainly by C/Ps with support of JICA expert by using mainly survey equipment donated by JICA. While topographic survey and bathymetric survey along Pakthoay site was conducted by local survey company under the supervision of C/P officials and JICA experts. Scope of each conducted survey work is as shown below:

a) Topographic survey and bathymetric survey along Pakthoay site

The topographic map which covers expected area of river bank protection at Pakthoay site was prepared. The field surveys at site were jointly conducted by Survey Company, C/P officials and JICA experts during January and February of 2012. Outline of topographic survey is as shown below.

Length of River Bank:	Approximately 280m
Cross Section:	14 sections
Total Area:	32,690.76 m^2

b) Current survey (conducted in March and August 2012)

Current of Mekong river flow in front of Pakthoay site was measured by float method. Float was made of bamboo with flag and weight so as to make it upright.

c) Water level survey

Water staff gauges were installed at Pakthoay site on February 22, 2012. Daily water level has been recorded by C/P personnel.

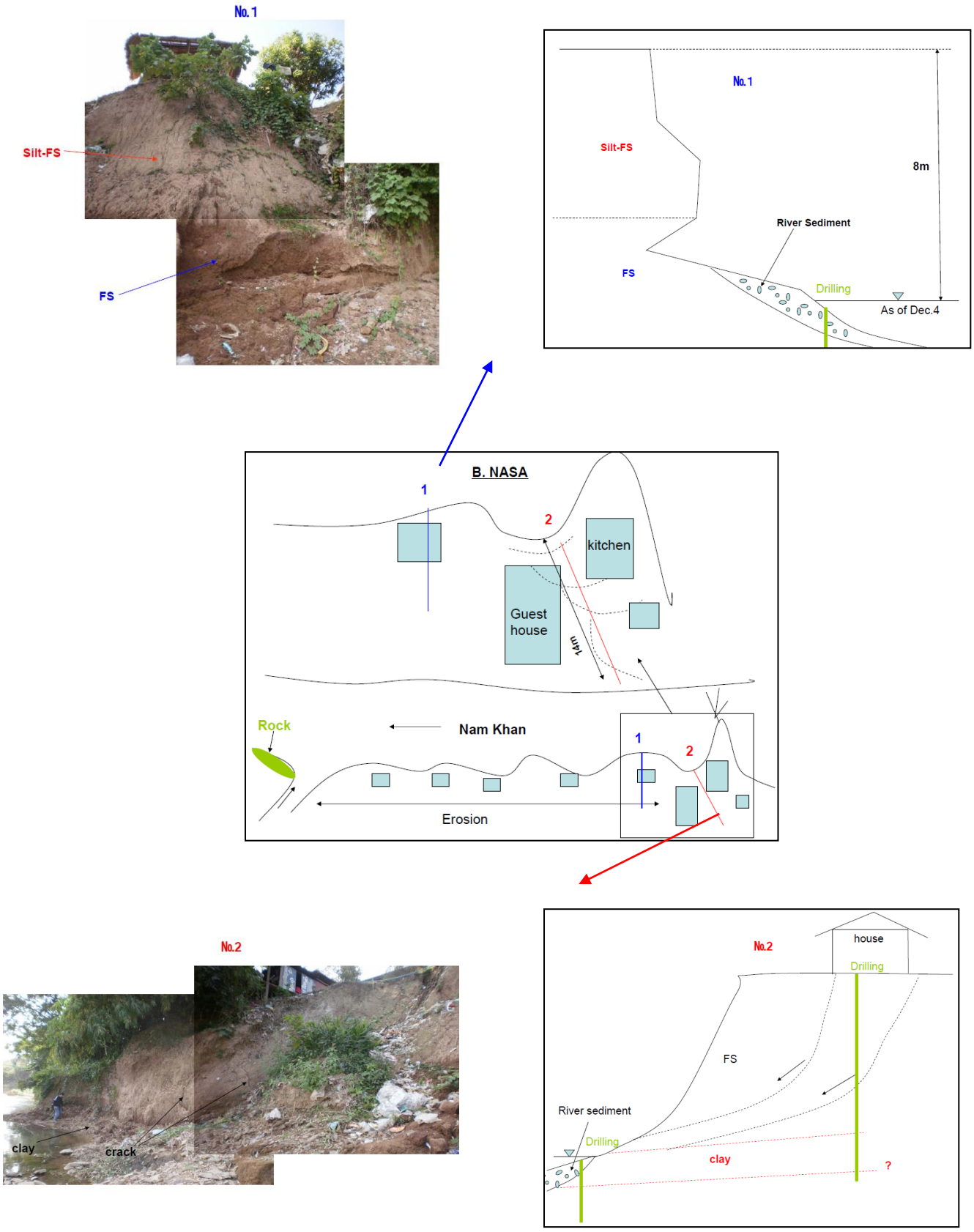
d) Survey of cross section of the Mekong River

Cross section survey across the Mekong River (from Lao side water edge to Thai side water edge) was conducted by C/P officials in February 2012. Cross section line was approximately right angle to riverbank of the Mekong River at Pakthoay site with the length of approximately 700m up-to riverbank of Thai side.

3) Luangprabang Province

Survey work for executing the riverbank protection work at Souanlouang (Nasa) site in Luangprabang Province consisting of: a) Topographic survey and bathymetric survey, b) Current survey, c) Water level survey and d) Survey of cross section of the Khan River were conducted. Those works were conducted mainly by C/Ps with support of JICA experts by using survey equipment mainly donated by JICA. Topographic survey and bathymetric survey along Souanlouang (Nasa) site were conducted by local survey company under the supervision of C/P officials and JICA experts.

In addition, geological investigation was recommended by JICA expert at Souanlouang (Nasa) site to confirm geological features of riverbed as well as riverbank for planning and design of riverbank protection work based on the survey result of riverbank erosion situation in the first year (refer to Fig. 3.4-2). Therefore, e) Drilling test was also conducted by local geological survey company under the supervision of C/P officials and JICA experts.



Source: The Project on Riverbank Protection Works Phase II, Annual Work Completion Report (1st Year), JICA, August 2011

Fig. 3.4-2 Geological Sketch at Ban Souanlouang (Ban Nasa)

Scope of respective conducted survey works are as shown below:

a) Topographic survey and bathymetric survey along Souanlouang site

The topographic map which covered the area of planned river bank protection at Souanlouang (Nasa) site was prepared. The field surveys at the site were jointly conducted by a survey company, C/P officials and JICA experts during February and March of 2013. Outline of topographic survey is as shown below.

Length of River Bank:	Approximately 290m
Cross Section:	18 sections
Total Area:	15,854.80 m^2

b) Current survey

Current of Khan River flow in front of Souanlouang (Nasa) site was measured by float method. Float used for the main stream of Mekong River was made of bamboo with flag and weight, however, plastic bottle was used as a float for current survey of Khan River because of its shallow depth.

c) Water level survey

Water staff gauges were installed at Souanlouang (Nasa) site on May 15, 2013. Water level of Khan River has been observed since 1960s at water level gauging station at Ban Mout located about 34.8 km upstream from the confluence between Mekong River and Khan River, and about 3.4 km upstream from Souanlouang (Nasa) site (refer to Fig. 3.4-3). There are no large tributaries incoming from Ban Mout to Souanlouang (Nasa) site. Therefore, in planning and design for riverbank protection works at Souanlouang (Nasa) site, discharge at Ban Mout calculated from stage-discharge relationship (H-Q curve) was utilized. For this purpose, water level record at Souanlouang (Nasa) site observed by C/P officials was compared with those of Ban Mout to check the relationship between the two (2) sites.

d) Survey of cross section of the Khan River

Cross section survey of the Khan River was conducted as well as topographic survey along Souanlouang (Nasa) site for around the same period. Two (2) cross section lines at 0+098.012 (IP1) and 0+0288.218 (IP-END) were surveyed. Also bathymetric survey at 0+098.012 (IP1) during high water season was conducted by C/P official in August 2013.

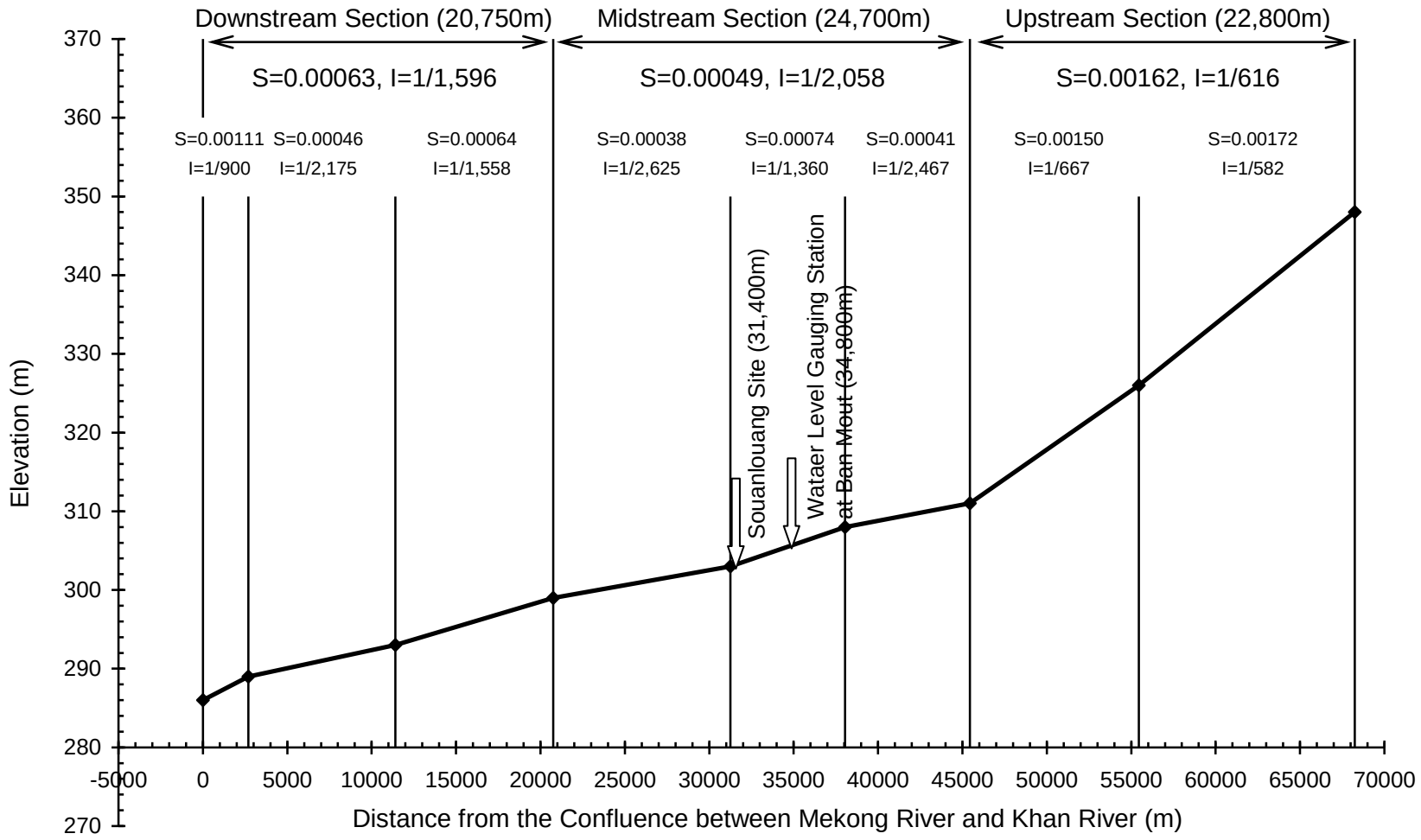


Fig. 3.4-3 Longitudinal Profile of Khan River by GPS Survey

e) Drilling Test

Drilling test was conducted to confirm geological features of riverbed as well as riverbank along Souanlouang (Nasa) site. The field survey at the site was jointly conducted by a geological survey company, C/P officials and JICA experts in February 2013. Outline of drilling test is as shown below.

Number of Boreholes:	3
Drilling Depth:	10m (Riverbed: D-1), 15m (Riverbank: D-2 and D-3)
Laboratory Test:	Density, Specific gravity, Natural water content, Grain size gradation, Atterberg limit, Consolidation test, Triaxial compression test (CU-bar)

If drilling test were designated as an essential item for survey and planning of riverbank protection works, smooth implementation of future project for riverbank protection by Lao side might be disturbed due to limitation of the budget. Therefore, the result of drilling test at Souanlouang (Nasa) site as well as the criteria for determining whether drilling test is necessary or not are compiled and attached to the manual for survey and planning on riverbank protection works.

(2) Design of the riverbank protection work

Using information and data acquired from implementation of (1), design of cross-section of riverbank protection work was performed.

1) Bokeo Province

Design of riverbank protection work selected in Bokeo Province was conducted in the collaboration of C/P officials and JICA experts. Design work consists of mainly, a) Determination of design water levels, b) Calculation of design flow velocity, c) Preparation of design drawings for the selected type of riverbank protection work. Each item is described briefly as follows:

a) Determination of design water level

Design water level consists of i) Water level at bankfull discharge, that is, riverbank elevation, ii) Water level in February for construction work, iii) Low water level for construction work and formation of riverbank protection work structure. Water level was calculated by uniform flow formula.

b) Calculation of design flow velocity

Corresponding water flow velocity to water level was also calculated by uniform flow formula.

c) Preparation of design drawings

Riverbank protection work selected in Bokeo Province consists of i) Cobble Stone with Soda Work as slope protection work, ii) Rip-rap foundation work and iii) Soda Mattress as foot protection work, considering the design condition at Paoy site, situation of riverbank protection works done in the previous stage of riverbank protection work in Lao and progress in capability of construction work by Lao contractor. Especially the Soda Mattress of 10m × 10m size was

applied for securing the safety of structure. Typical cross section was prepared and applied on other cross sections in the construction site.

2) Bolikhamxay Province

Design of riverbank protection work selected in Bolikhamxay Province was conducted in the collaboration of C/P officials and JICA experts. Design work consists of mainly, a) Determination of design water levels, b) Calculation of design flow velocity, c) Preparation of design drawings for the selected type of riverbank protection work. Each item is described briefly as follows:

a) Determination of design water level

As the expected highest water level, EL 151.288 m calculated from peak discharge of 2008 flood was applied for design water level.

b) Calculation of design flow velocity

Corresponding water flow velocity to water level was also calculated by uniform flow formula.

c) Preparation of design drawings

Riverbank protection works selected for Pakthoay site consists of i) Cobble stone with Soda work as slope protection work, ii) Rip-rap foundation work and iii) Soda mattress as foot protection work; however, Soda mattress should be installed only water colliding front section because of difficulty in installation due to topographic condition at Pakthoay site.

Based on the centerline by topographic survey, design centerline of riverbank protection works is determined to satisfy the following conditions:

- The sacred tree near No. 0+30m shall not be cut down.
- Considering the efficiency of construction work on Soda mattress installation, water depth at the bank shall be ensured at approximately 1.0m when Soda mattress will be installed.
- Cut and fill (mass balance) for earthwork shall be considered.

3) Luangprabang Province

Design of riverbank protection work selected in Luangprabang Province was conducted in the collaboration of C/P officials and JICA experts. Design work consists mainly of, a) Determination of design water levels, b) Calculation of design flow velocity and c) Preparation of design drawings for the selected type of riverbank protection work. Each item is described briefly as follows:

a) Determination of design water level

As the expected highest water level, the design water level at Souanlouang (Nasa) site was determined by using discharge calculated for peak water level observed at water level gauging station at Ban Mout during August 2012 flood.

b) Calculation of design flow velocity

Corresponding water flow velocity to water level was also calculated by the uniform flow formula.

c) Preparation of design drawings

Riverbank protection works selected for Souanlouang (Nasa) site consists of i) Cobble Stone with Soda Work as slope protection work, ii) Riprap Foundation Work and iii) Soda Mattress Work as foot protection work.

Three (3) alternatives were prepared for the variation of the distances between design centerline of riverbank protection works and the centerline by topographic survey as shown in Table 3.4-1, and comparative study was conducted by C/P officials. As the result, C/P officials prioritized the alternatives and finally Plan-C (design centerline was shifted 5m toward river center from the centerline by topographic survey) was adopted through the discussion between C/P officials and JICA experts.

On the other hand, JICA experts suggested dividing the structure into two (2) sections as shown in Fig. 3.4-4 (hereinafter referred to as "JICA Experts' Plan") due to the following reasons:

[Downstream Section (from 0+000m to 0+100m, L=100m)]

- Steep slope of riverbank caused by erosion.

→ Installation of riverbank protection works is recommended.

[Middle Section (from 0+100m to 0+200m, L=100m)]

- Inflow of small stream exists at around 0+120m.
- Mild slope of riverbank and no significant erosion.
- If installation of riverbank protection works were carried out, huge amounts of soil would be obtained by cutting slope.

→ Installation of riverbank protection works is "NOT" recommended.

[Upstream Section (from 0+200m to 0+240m, L=40m)]

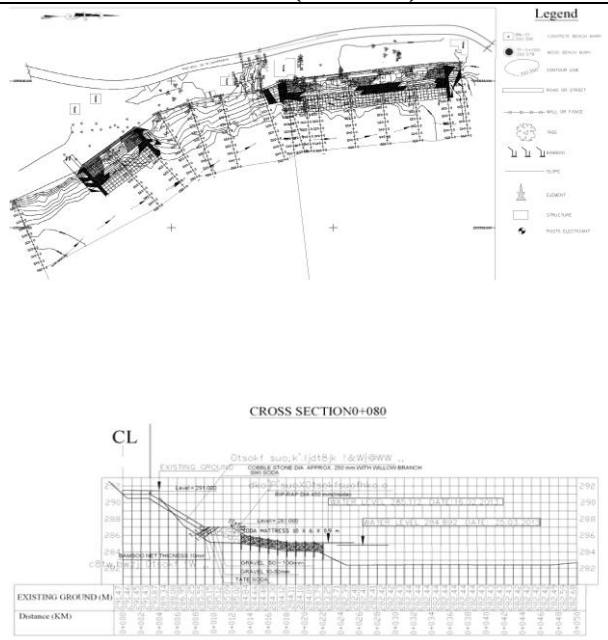
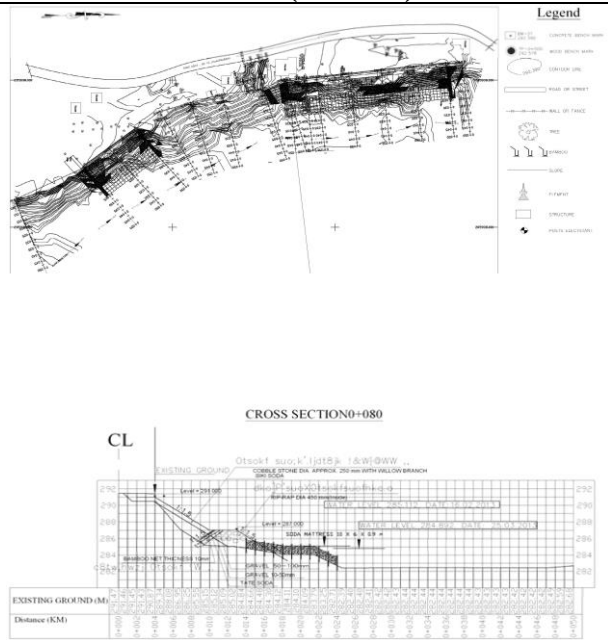
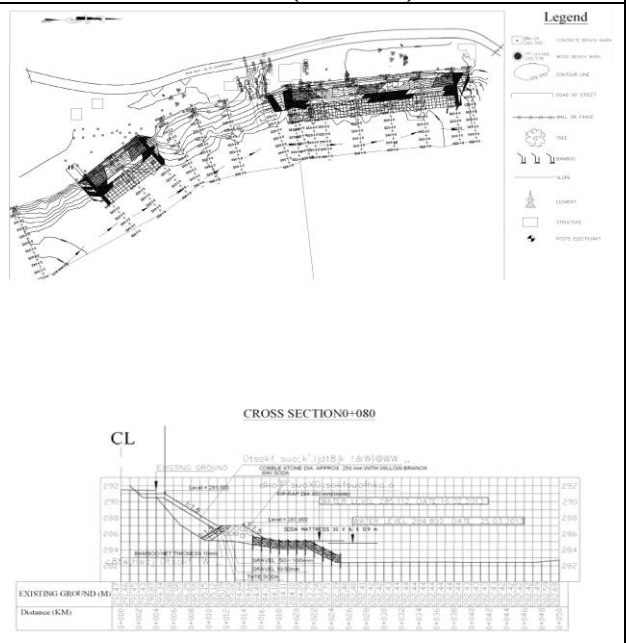
- Steep slope of riverbank caused by erosion.

→ Installation of riverbank protection works is recommended.

To the JICA Experts' Plan, C/P officials provided their counter-proposal as shown in Fig. 3.4-5 (hereinafter referred to as "C/P Officials' Plan"). Through the discussion between JICA experts and C/P officials, both sides agreed in the third year with the following policies:

- Through the project activities for the third year, JICA Experts' Plan was adopted.
- C/P officials should master total process on design, quantity survey and cost estimation of JICA Experts' Plan under the guidance of JICA experts, and proceed to complete C/P Officials' Plan by their own effort during the absence of JICA experts.
- Comparative study will be jointly conducted in November 2013 by C/P officials and JICA experts as part of the project activities for the fourth year. In case that JICA Experts' Plan is selected, JICA experts will have no objection to the future implementation of extra bank protection work for the section from 0+100m to 0+200m by Lao side's own budget.

Table 3.4-1 Comparative Study Conducted by C/P Officials for Design Centerline of Riverbank Protection Works at Souanlouang Site

	Plan-A (CL+3.0m)	Plan-B (CL+4.0m)	Plan-C (CL+5.0m)
Plan and Typical Cross Section			
Merit	✓ Cost for cutting slope is cheaper than that of filling. ✓ Cutting slope is structurally strong.	✓ Construction cost is appropriate. ✓ Plan-B saves more land to local residents than Plan-A.	✓ Local residents accept Plan-C because of its land use. ✓ The government also accepts Plan-C to protect the land for local residents.
Demerit	✓ Threat on damage of national road No. 13 by riverbank erosion is not eliminated. ✓ Loss of land is not accepted by local residents.	✓ Loss of land is not accepted by local residents.	✓ Construction period is long.
Construction	Difficult	Intermediate (between Plan-A and Plan-C)	Good (Workable)
Cost	Inexpensive	Intermediate (between Plan-A and Plan-C)	Expensive
Estimation	Not Good	Fair	Very Good
Note	This plan is not acceptable by the government.		Keeping good relationship with local residents is important. Therefore, this plan is appropriate.

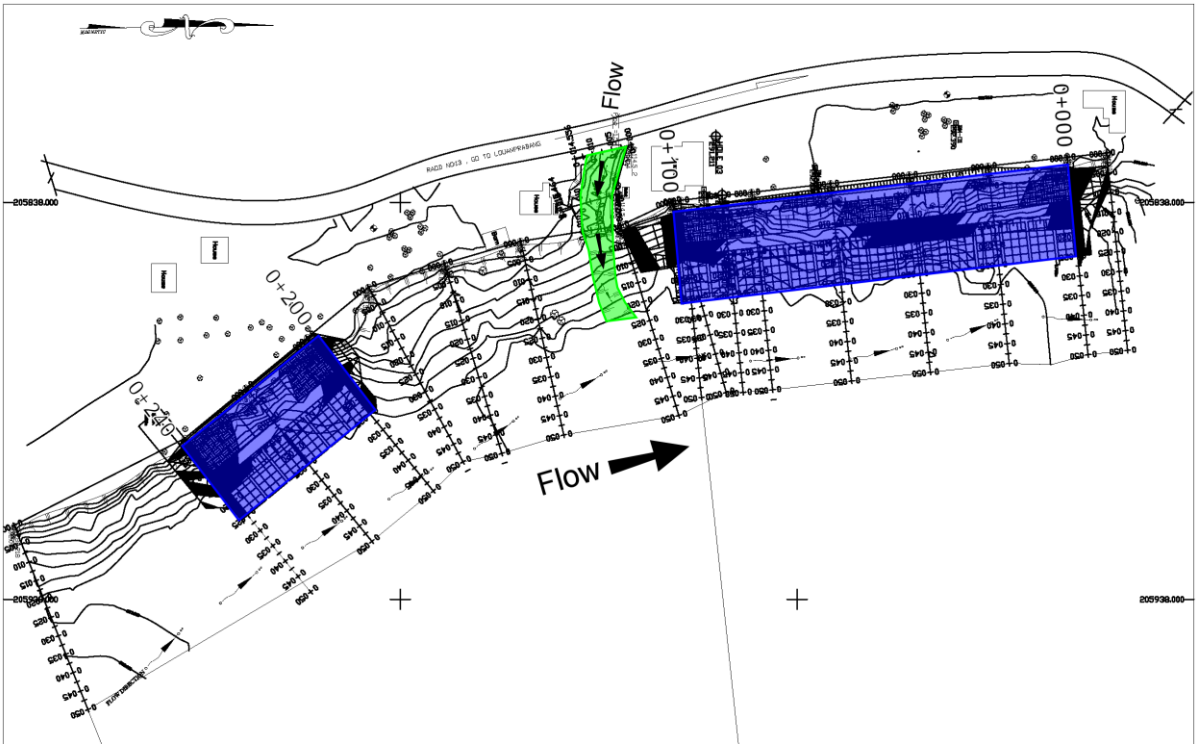


Fig. 3.4-4 Layout of Riverbank Protection Works at Souanlouang (Nasa) Site (JICA Experts' Plan in the Third Year, Total Length: 140m)

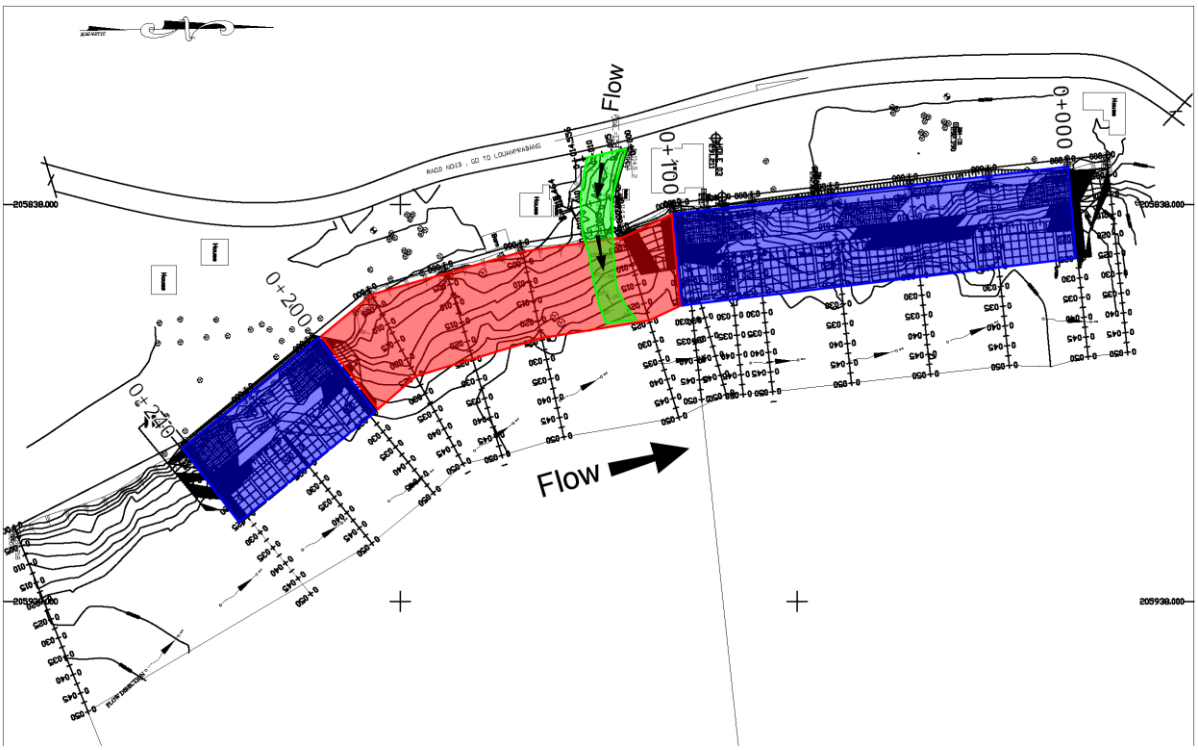


Fig. 3.4-5 Layout of Riverbank Protection Works at Souanlouang (Nasa) Site (C/P Officials' Plan in the Third Year, Total Length: 240m)

In the beginning of the fourth year, C/P officials provided their revised plan in which length of upstream section was 100m (from CS 0+140m to CS 0+240m) and total length of structures was 200m and strongly requested to Japanese side to adopt for cost-sharing project. Therefore several discussions were held and finally both sides agreed to adopt their revised plan as shown in Fig. 3.4-6 for the bidding of riverbank protection works for Souanlouang (Nasa) site.

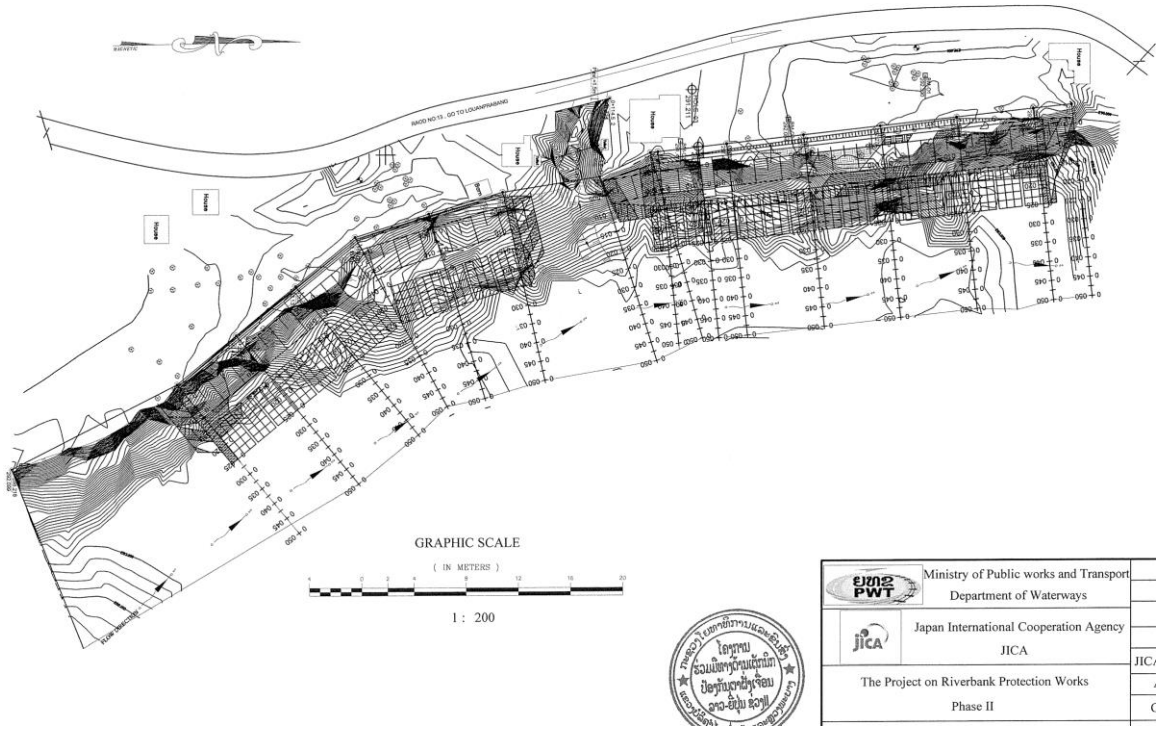


Fig. 3.4-6 Layout of Riverbank Protection Works at Souanlouang (Nasa) Site (Adopted for Bidding Document in the Fourth Year, Total Length: 200m)

Furthermore, additional riverbank protection works for total length of 40m (from CS 0+100m to CS 0+140m) including confluence between small stream and Khan River (refer to Fig. 3.4-7) was also conducted by Lao side with their own budget.

Fig. 3.4-7 Layout of Riverbank Protection Works at Souanlouang (Nasa) Site (Additional Works Including Confluence Between Small Stream and Khan River, Total Length: 40m)

(3) Determining the executional cross-section and the range of work within the project budget

Information for cost estimation such as standard unit cost of materials, labor cost per hour, etc. were collected. As for materials and work methods not included in the above information, description of the past construction works and their amount of contract to estimate unit cost of materials, labor cost, etc. were surveyed. As for materials not used in the previous construction works, survey through hearing investigation or questionnaires to two or more companies to determine unit cost, etc. were considered. Based on information acquired through the above processes, construction cost for cross-section design acquired in the process of (2) was estimated, and then actual cross-section to be implemented and range of protection work based on the project budget was determined.

1) Bokeo Province

a) Existing Condition of the Construction Site

The existing condition of construction site at Paoy was surveyed with the C/P officials of DPWT Bokeo Province in view of access road, temporary stock yard, construction temporary road, electricity supply and water supply.

- Access road from Houayxay town has enough capacity for transportation of labor, construction material and machine.
- Temporary stock yard is available in local private business and Paoy village at the site.
- Critical place is not recognized for the temporary construction road in land use condition.
- Temporary facilities of electricity and water supply are available in the construction site.
- Environmental problem is not critical as to ambient noise, dust control and traffic control,

for which any further countermeasures are not required.

The location and site picture of the existing condition at construction site is as shown in Fig. 3.4-8.

b) Construction Range

Unit price survey for construction cost was carried out through interview, site visit, and reference of past construction work. The followings are found through the survey.

- Prices of cobble stone and river gravel are lower than the prices at Vientiane because of short material handling distance.
- US Dollar and Thai Bahts currencies are required from the market of Bokeo Province. Japanese Yen is high in current foreign money exchange market.
- Labor is available in Paoy village and the labor cost is lower than that in Vientiane.
- Local Construction Company (Mitappab, Meuang Phai Linh) is available in Bokeo Province.

In the design of structure, the structure type with slope protection until the crest at Dongphoshi site in Vientiane Capital shall be applied for Paoy site. Compared with the type at Dongphoshi, the difference of the design for Paoy site was recognized as below.

- Less height from the river bed
- Less volume of embankment material in the slope
- Less volume of rock foundation
- No usage of additional riprap for the strengthening applied in Dongphoshi site

Unit price per river length (m) for construction was less estimated than at Dongphoshi site. As of middle of May 2011, the construction unit price per river length (m) was supposed as US$ 1,500 per meter. The construction range of 200 m length was possible, based on the assumed unit price.

2) Bolikhamxay Province

For the cost estimation toward the bidding on pilot project in Bolikhamxay Province for the third year, information for cost estimation such as standard unit cost of materials, labor cost per hour, etc. were collected in the second year. As for materials and work methods not included in the above information, description of the past construction works and their amount of contract to estimate unit cost of materials, labor cost, etc. were surveyed.

Fig. 3.4-8 Location and Site Pictures of Paoy Site in Bokeo Province

3) Luangprabang Province

For the cost estimation toward the bidding on pilot project in Luangprabang Province for the fourth year, information for cost estimation such as standard unit cost of materials, labor cost per hour, etc. were collected in the third year. As for materials and work methods not included in the above information, description of the past construction works and their amount of contract to estimate unit cost of materials, labor cost, etc. were surveyed.

(4) Determining the construction contractors who participate in the three pilot projects based on an appropriate method

For the implementation of three (3) pilot constructions in this Project, cost-sharing approach between Lao side and Japanese side was adopted. Therefore bidding procedure should comply with both "Procurement Manual published by Ministry of Finance of Lao P.D.R. in May 2009" and "JICA Guidelines for Sub-contract under the Consulting Services in June 2006 (revised in April 2012)".

Items described in Procurement Manual related to the bidding for three (3) pilot constructions in this Project are as follows:

- For the Works of estimated amout is greater than 500,000,000 kip (6.0 million Yen, equivalent), less than or equal to 25,000,000,000 kip (300.0 million Yen), National Competitive Bidding (NCB) is applied.
- The Bidding Committee, established in advance for the bidding, has the rights and duties on preparation and approval of bidding documents, evaluation of bidding documents, decision of successful bidder.

1) Bokeo Province

The construction budget for the original design made out by the Technical Cooperation Project Team, was estimated in November 2011 based on the market price, unit cost in the past pilot projects. After finding some difference of the Soda mattress position and increased construction cost, the design was adjusted so that the construction cost becomes below the budget for pilot construction work.

Public notification for bidding was appeared in newspapers on November 22 and 23, 2011. Bidding document was distributed from November 28, 2011 and six (6) companies purchased it. Pre-bid meeting was held on December 1, 2011 and bid opening was held on December 6, 2011 with the attendance of representative from JICA Laos office. As a result, four (4) companies participated in this bidding.

Based on the bid evaluation result, Bidding Committee negotiated with the lowest bidder and awarded the contract.

Above-mentioned procurement process was approved by Director General of DoW on December 15, 2011 and Minister on December 20, 2011.

2) Bolikhamxay Province

Open competitive bidding was adopted as bid type and the lowest-price bid was applied as a

successful bidder for the first pilot construction work in Bokeo Province. However, the successful bidder's capability for construction was not sufficient to conduct riverbank protection works.

Based on this lesson learned, overall evaluation bidding was adopted as bid type for the second pilot construction work in Bolikhamxay Province. For this purpose, JICA experts proposed that the bill of quantities (BOQ) without indicating quantities should be enclosed in the bidding documents and requested the bidders to propose quantities by their own effort to evaluate the capability. Members of Bidding Committee were initially against to the proposal of JICA experts, because of a lack of precedent. Therefore, JICA experts made steady efforts in convincing the committee members stating that it is worth trying the proposed new way in the Phase II Project in order to select the better qualified contractor, which was in line with the purpose of Phase II Project that was a capacity development of river engineers in Lao P.D.R. including not only government officials, but also private construction companies. In addition, BOQ without indicating quantities had been used in Development Study for the bidding of three (3) pilot riverbank protection works in Vientiane Capital. Finally BOQ without indicating quantities was adopted by the committee members.

Notification for bidding was published in a newspaper on December 19, 2012 and the pre-bid meeting was held on December 21, 2012 (refer to Photo 3.4-1). After that the bid opening was conducted on January 8, 2013 with the attendance of the representative from JICA Laos office. Although 13 companies purchased the bidding document, eight (8) companies participated in this bidding.

Photo 3.4-1 Pre-bid Meeting (Left: DoW, MPWT and Right: Pakthoay Site)

After bid evaluation, Bidding Committee prepared the evaluation report and it was approved by H.E. Mr. Sommad PHOLSENA, Minister of MPWT on January 23, 2013. After that the Bidding Committee had a contract negotiation with successful bidder and awarded the contract on January 24, 2013.

3) Luangprabang Province

For the third pilot construction work in Luangprabang Province, members of Bidding Committee agreed to adopt overall evaluation bidding which is the same as second one based on the lesson learned as described in 2).

Notification for bidding was published in a newspaper on December 17 and 18, 2013 and the pre-bid meeting was held on December 20 and 21, 2013 (refer to Photo 3.4-2). After that the bid opening was conducted on January 10, 2014 with the attendance of the representative from JICA Laos office.

Although 10 companies purchased the bidding document, three (3) companies participated in this bidding.


Photo 3.4-2 Pre-bid Meeting (Left: DoW, MPWT and Right: Souanlouang (Nasa) Site)

After bid evaluation, Bidding Committee prepared the evaluation report and it was approved by H.E. Mr. Sommad PHOLSENA, Minister of MPWT on January 28, 2014. After that the Bidding Committee had a contract negotiation with successful bidder and awarded the contract on January 31, 2014.

(5) Construction supervision of the riverbank protection work

1) Bokeo Province

Due to change of riverbank situation at the construction site, topographic survey was implemented to reconfirm the present topographic features. Causes for change of riverbank situation are summarized as follows:

- Riverbank at the site has been eroded more during wet season after the implementation of original topographic survey in March 2011.
- Water level during construction period was lower than designed low water level due to abnormal climatic condition and so forth.

Design drawings were modified based on the survey result and request from DPWT Bokeo Province as follows:

- Slope protection by cobble stone with Soda works covered up to the top of the bank.

On February 18, 2012, both Technical Cooperation Project Team and the Contractor confirmed that the difference in cost if occurred by variation, claim for increase of the contract price was not allowed by the Contractor in accordance with Clause 3 of Article 12 of the General Conditions of the Contract. Therefore DPWT Bokeo Province would like to negotiate with MPWT regarding the additional budget for the construction. Japanese side was not necessary to prepare additional payment.

After the discussion, however, situation of construction has been changed as shown below.

- Mr. Houngla SENGMUANG, Director General of DoW, MPWT didn’t give his permission for additional budget for construction and replied not to change the original concept of design

drawings attached to the Contract. Therefore Slope protection by cobble stone with Soda works from 0+200m to 0+280m covered up to the first berm, and design drawings were modified again.

- In May 2012, the Contractor requested Technical Cooperation Project Team that they would like to have approval of work completion due to the accomplishment of bill of quantities (BOQ) even its actual achievement of construction seemed to be 94% (estimation by Technical Cooperation Project Team). Technical Cooperation Project Team ordered the Contractor to submit the evidence such as as-built drawings and final BOQ and so forth to evaluate the completion of the construction work.
- In August 2012, Lao side announced to Japanese side that they had to pay for the final payment equivalent to 30% of contract price paid by Lao side even the Contractor had not been able to submit the evidence such as as-built drawings and final BOQ and so forth to Technical Cooperation Project Team because the maturity date for the fiscal year* 2011 of Lao P.D.R. was August 15, 2012.
  Lao side also expressed to Japanese side that they would continue negotiation with the Contractor for the pending certificate of completion of the construction work.

* Fiscal year of Lao P.D.R. for the year 2011 is from October 1, 2011 to September 30, 2012

Photo 3.4-3 On-site Training to C/P Officials, Contractor and Local Labors by JICA Experts

Photo 3.4-4 Progress Situation of Pilot Construction Work as of February 2012


Photo 3.4-5 Progress Situation of Pilot Construction Work as of March 2012


Photo 3.4-6 Progress Situation of Pilot Construction Work as of April 2012


Photo 3.4-7 Progress Situation of Pilot Construction Work as of May 2012

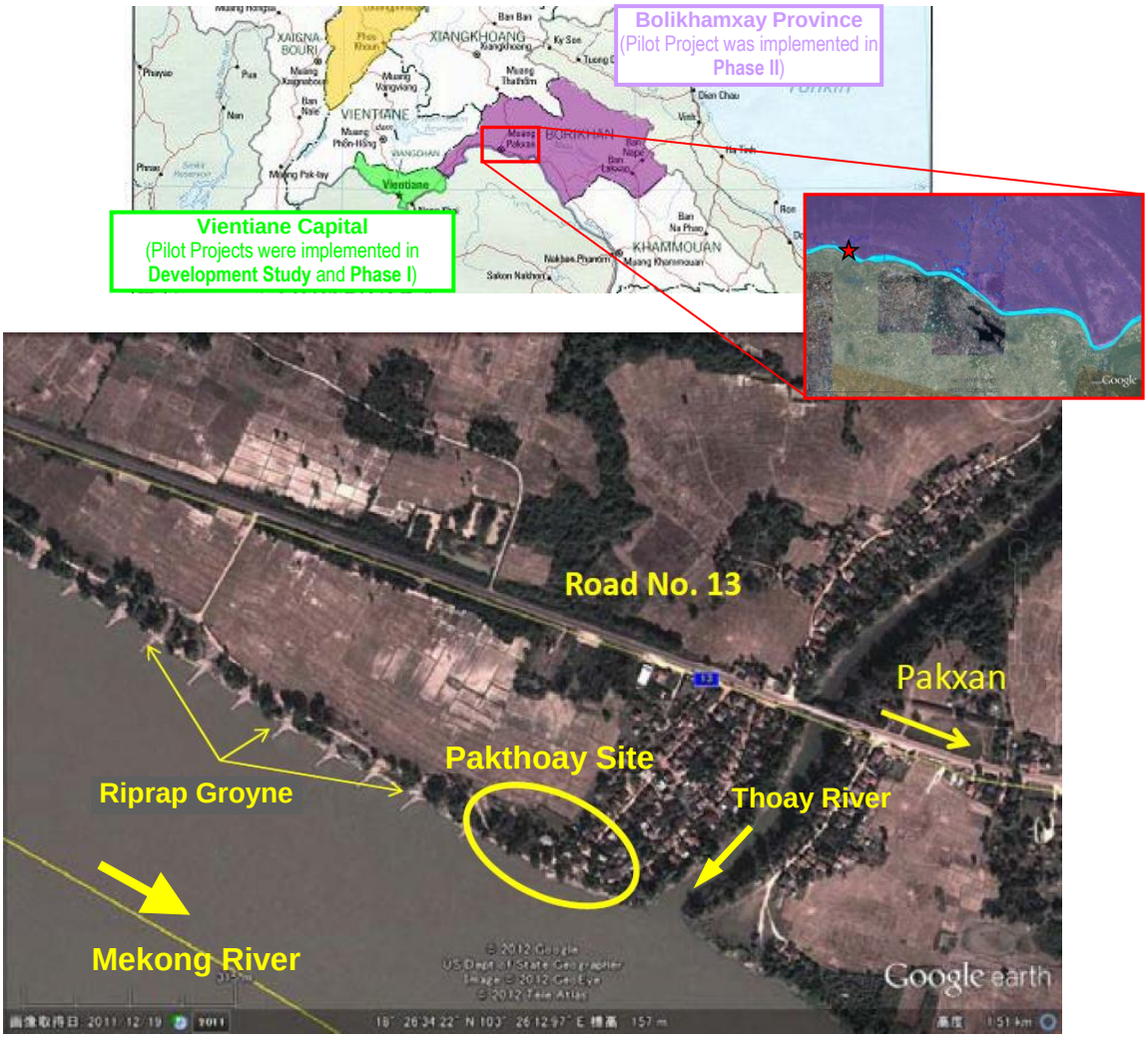
2) Bolikhamxay Province

Technical Cooperation Project Team made a contract with the Contractor in the end of Janualy 2013 and construction works started in February 2013. Although delay of construction period was worried about due to the continuation of stormy weather after April, C/P officials supervised the construction works by the Contractor based on the instruction of JICA experts and construction works was completed by the end of May 2013. After that the final inspection was conducted on June 12, 2013

a) Condition of Pilot Construction Site

Pakthoay Village of Thaphabath District is located at approximately 20 km westward along

National Road No. 13 from Pakxan City, capital of Bolikhamxay Province (refer to Fig. 3.4-9). Construction site is located at the riverbank along the Mekong River, in front of Buddha Temple. Situation of riverbank erosion at Pakthoay site as of May 2012 is as shown in Photo 3.4-8. Riprap Groyne Work for riverbank protection had been done at just upstream of Pakthoay site by DPWT Bolikhamxay Province. Confluence between Mekong River and Thoay River is located just downstream of Pakthoay site.



(c)Google

Fig. 3.4-9 Location Map of Pakthoay Site


Photo 3.4-8 Situation of Riverbank Erosion at Pakthoay Site as of May 2012

b) Main Works for Pilot Construction

Riverbank protection works for Pakthoay site consists of i) Cobble Stone with Soda Work as slope protection work, ii) Riprap Foundation Work and iii) Soda Mattress Work as foot protection work (refer to Fig. 3.4-10).

		
[Slope Protection] Cobble Stone with Soda Work Slope Area: 4,290 m^2 Rock Size: ϕ 150 – 250 mm	[Foundation] Riprap Foundation Work Volume: 4,500 m^2 Maximum Rock Size: ϕ 450 mm	[Foot Protection] Soda Mattress Work Asssembling on Bamboo Raft Unit: 5 (Size: 6m×10m×0.9m)

Fig. 3.4-10 Profile of Main Works for Pilot Construction at Pakthoay Site

c) Materials Used for Pilot Construction

The material of Soda, Taisya, Kogui, and Fascine (Ryushi) is similar to the material used for the pilot construction works at Paoy Village in Bokeo Province.

The sand and gravel for the embankment of the slope shall be the material obtained by the trimming and cutting of the slope or the material procured from the local market. In addition, local material from the quarry used for small-scale embankment* was also allowed to divert as gravel for pilot construction after the demonstration finished.

* Demonstration of Cobble Stone with Soda Work was carried out as a part of seminar held in Bolikhamxay Province in the end of March 2013. For demonstration, small-scale embankment was established to make a slope at the top of the riverbank at Pakthoay site. Material for embankment was collected as a test at the quarry near Pakthoay site.

d) Standard Unit Requirement and Material Quantity

For Cobble Stone with Soda Work, standard unit requirement of the construction per 10 m^2 was estimated through the traditional work experience in Japan (refer to Table 3.4-2).

The total material quantity for Soda Mattress Work and Cobble Stone with Soda Work was estimated based on the unit rate requirement per 10 m^2 as shown in Table 3.4-3.

Table 3.4-2 Unit Requirement per 10 m^2 for Cobble Stone with Soda Work

Title	Dimension	Unit	Count
Worker		Person	4.7
Soda	L=3.0m, Round=0.7m	Bundle	9.0
Taisya	L=3.0m, 25 twig	Bundle	3.0
Kogui	L=1.2m, d=40mm, (10 twig)	Bundle	3.0
Fascine	L=1.2m, Round=0.9m	Bundle	1.0
Cobble Stone	d=150 – 250 mm	m3	1.0
Sand/Gravel Fill		m3	2.0

Table 3.4-3 Material Quantity for Soda Mattress Work and Cobble Stone with Soda Work

Item	Specification	Unit	Rate/10m^2	Quantity
Soda Mattress Work (6m*10m*0.9m)				**5 sheets**
Soda	Length: 2.7m, 45cm rise peripheral 60cm 200cm rise peripheral 55cm	bundle	67	1,809
Taisya	Length: 2.7m, ϕ 2 – 3cm at butt end ϕ 1.0cm at 2.7m rise 25 twigs per bundle	bundle	3	81
Kogui	Length: 1.2m, ϕ 3 – 5cm at butt end 10 pieces/bundle	bundle	3	81
Rubble stones	ϕ 450 mm 8 – 30 Kg/piece	m^3	3.5	94.5
Straw rope	ϕ 10 mm, 110 – 140m	role	3	81
Zinc-coated whip	#10	Kg	3	81
Zinc-coated whip	#12	Kg	3	81
Cobble Stone with Soda Work (Slope Protection Work)				**4,290 m^2**
Siki Soda	L=3.0 m, S=0.7 m, 25 twigs/bundle	bundle	9	3,861
Taisya	L=3.0 m, 1 bundle =25 twigs/bundle	bundle	3	1,287
Kogui (Short Pile)	L=1.2 m, ϕ =4 cm, 10 piece/bundle	bundle	3	1,287
Willow branch	L=1.2 m, S=0.9 m, 25 twigs/bundle	bundle	1	429
Cobble	ϕ =150 – 250 mm/piece	m^3	1	429
	ϕ 150 mm for Slope A and Berm ϕ 250 mm for Slope B	m^3 m^3	1 1	213 216

e) Construction Supervision

Based on the lesson learned from the first pilot construction work in Bokeo Province, both

Japanese side and Lao side had discussed and agreed that C/P officials from DPWT Bolikhamxay Province should be assigned as construction supervisors for the second pilot construction work in Bolikhamxay Province. However, they occasionally appeared at the site during construction period even though JICA experts frequently asked for the participation. For capacity development on construction supervision, it was recommended for further participation of C/P officials from DPWT Bolikhamxay Province.


Photo 3.4-9 On-site Training to C/P Officials, Contractor and Local Labors by JICA Experts


Photo 3.4-10 Progress Situation of Pilot Construction Works as of February 2013


Photo 3.4-11 Progress Situation of Pilot Construction Works as of March 2013


Photo 3.4-12 Progress Situation of Pilot Construction Works as of April 2013


Photo 3.4-13 Progress Situation of Pilot Construction Works as of May 2013

f) Final Inspection

As the pilot construction works did not complete before JICA experts had left Lao P.D.R. in May 2013, Chief Advisor revisited to attend the final inspection at Pakthoay site on June 12, 2013.


Photo 3.4-14 Completion of Pilot Construction Works as of June 2013


Photo 3.4-15 Situation of Final Inspection on June 12, 2013

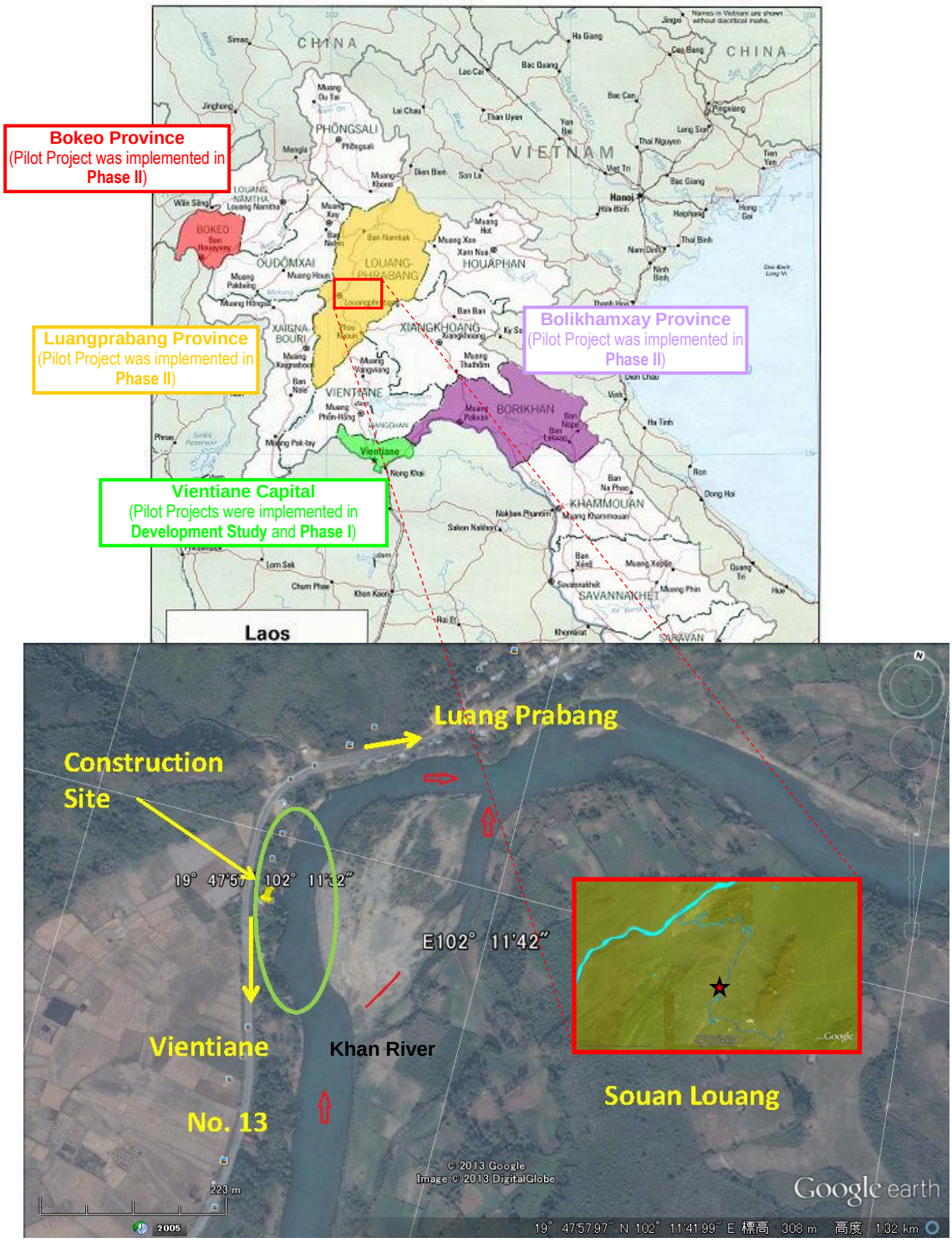
3) Luangprabang Province

Technical Cooperation Project Team made a contract with the Contractor in the end of January 2014 and construction works started in February 2014. C/P officials supervised the construction works by the Contractor based on the instruction of JICA experts and construction works completed by the end of May 2014. After that the final inspection was conducted on June 18, 2014

a) Condition of Pilot Construction Site

Souanlouang (Nasa) Village of Xiang Ngeun District is located along National Road No. 13. Linear distance between the center of Luangprabang City and Souanlouang (Nasa) Village is approximately 12 km south-southeastward (refer to Fig. 3.4-11). Although previous two (2) pilot construction were implemented at the riverbank along the Mekong River, last pilot construction site was selected at the riverbank along the Khan River, which is typical tributary of the Mekong River, to disseminate traditional riverbank protection works at not only main stream but also tributaries of the Mekong River. Situation of riverbank erosion at Souanlouang (Nasa) site as of January 2013 is as shown in Photo 3.4-16.


Photo 3.4-16 Situation of Riverbank Erosion at Souanlouang (Nasa) Site as of January 2013



(c)Google

Fig. 3.4-11 Location Map of Souanlouang (Nasa) Site

b) Main Works for Pilot Construction

Riverbank protection works for Souanlouang (Nasa) site consist of i) Cobble Stone with Soda Work as slope protection work, ii) Riprap Foundation Work and iii) Soda Mattress Work as foot protection work (refer to Fig. 3.4-12).

		
[Slope Protection] Cobble Stone with Soda Work Slope Area: 1,950 m^2 Rock Size: ϕ 350 mm	[Foundation] Riprap Foundation Work Volume: 970 m^2 Maximum Rock Size: ϕ 550 mm	[Foot Protection] Soda Mattress Work Asssembling on Riverbed in Dry Condition Unit: 31 (Size: 6m×10m×0.9m)

Fig. 3.4-12 Profile of Main Works for Pilot Construction at Souanlouang (Nasa) Site

c) Construction Supervision

Based on the lesson learned from the first pilot construction work in Bokeo Province, both Japanese side and Lao side had discussed and agreed that C/P officials from DPWT Bolikhamxay Province should be assigned as construction supervisors for the second pilot construction work in Bolikhamxay Province. However, they occasionally appeared at the site during construction period even though JICA experts frequently asked for the participation. For capacity development on construction supervision, it was recommended for further participation of C/P officials from DPWT Bolikhamxay Province. Above-mentioned issue was brought up from Japanese side at the third meeting of JCC in May 2013, and Lao side responded to express apologies on attitude of C/P officials in charge and committed to improve their attitude.

For this reason, construction supervision for the third pilot construction work in Luangprabang Province was drastically improved in terms of participation of C/P officials in charge compared with previous two (2) pilot construction works.

On the other hand, issues on construction supervision which have never occurred during the impremention of previous two (2) pilot construction works were revealed. For example, procurement of soda material and/or rock material as a component of assemble Soda Mattress tend to lingered previously. However delay of work this time was due to lack of stock of rope and/or steel wire, which is used to bind soda material and Rensai bundle, and lack of manpower. Despite necessary amount for rope and/or steel wire and manpower as well as soda material and rock material were preliminarily informed to the Contractor via C/P officials, it took much more time for procurement than expected and caused delay of work.

It is particularly worth noting for construction procedure that Soda Mattress was assembled on the dried-up riverbed directly by the diversion of riverflow (refer to Photo 3.4-17). As riverbed of the Mekong River is not dried up even in dry season, installation of Soda Mattress along the Mekong River was implemented by the crane, which is generally applied in Japan, or its assembly on the water by using bamboo raft which has been introduced to Lao P. D. R. in Phase I and also used to be applied in Japan before construction modernization (refer to Photo

3.4-18). Meanwhile water level of the Khan River in February 2014 was lower than that of February 2013. In addition, it was easy to install the coffer dam at upstream of the left bank due to the existence of holm (island) at Souanlouang (Nasa) site. Therefore river flow could be diverted easily and it was possible to assemble Soda Mattress on the dried-up riverbed.


Photo 3.4-17 On-site Training to C/P Officials, Contractor and Local Labors by JICA Experts


Photo 3.4-18 Installation Method of Soda Mattress in Previous Pilot Construction (Left: IDI Pilot Construction (2001) and Right: Pakthoay Site in Bolikhamxay Province (2013))


Photo 3.4-19 Progress Situation of Pilot Construction Works as of February 2014


Photo 3.4-20 Progress Situation of Pilot Construction Works as of March 2014


Photo 3.4-21 Progress Situation of Pilot Construction Works as of the end of March 2014


Photo 3.4-22 Progress Situation of Pilot Construction Works as of May 2014


Photo 3.4-23 Progress Situation of Pilot Construction Works as of May 2014

d) Final Inspection

As the pilot construction works did not complete before JICA experts had left Lao P.D.R. in May 2014, Chief Advisor revisited to attend the final inspection at Souanlouang (Nasa) site on June 18, 2014.


Photo 3.4-24 Completion of Pilot Construction Works as of June 2014


Photo 3.4-25 Situation of Final Inspection on June 18, 2014

3.4.3 Ability Improvement through Developing and Updating Manuals

Based on the manual for planning/design and manual for construction prepared in Phase I, manual for design, cost estimation and construction was prepared by adding knowledge and know-how acquired through the implementation of three (3) pilot projects. The revision work was done in collaboration with C/P officials and JICA experts.

Final edition of the manual which was translated into Lao by C/P officials with the cooperation of professors of National University of Laos (NUOL) is attached to annex of this report.

3.4.4 Improve Organizational Ability through Training Instructors and Establishing Training System by Providing Trainings and Seminars

Lecture programs on "Design and Construction of Riverbank Protection Works" were presented for the second, third and fourth training sessions and seminars as shown in Table 3.4-4 in association with revision of design, cost estimation and construction manual for further understanding of design and construction supervision field by C/P officials.

Table 3.4-4 Lecture Programs and Instructors on "Design/Construction of Riverbank Protection Works"

2nd Seminar (Bokeo Province) February 2, 2012 (Thu), February 3, 2012 (Fri) 40 Participants	The 1st day: February 2, 2012 (Thu)
	<09:20 – 10:00> Introduction of Pilot Construction at Ban Paoy, Bokeo Province *Instructor: Mr. Souksavanh THITHAVONG, DoW, MPWT Project Manager of Phase II*
3rd Seminar (Bolikhamxay Province) March 28, 2013 (Thu), March 29, 2013 (Fri) 35 Participants	The 1st day: March 28, 2013 (Thu)
	<09:20 – 10:10> Basic Concept of Countermeasures on Riverbank Erosion *Instructor: Mr. Khamphong THEPKHAMHEUANG, DPWT Bolikhamxay Province*
	<10:30 – 11:20> Construction Work at Pakthoay *Instructor: Mr. Khampheiuy LEEFHUNG, DoW, MPWT*
	<13:00 – 13:50> Procedure of Deciding the Design Velocity at Pakthoay *Instructor: Mr. Phimmasone SENGSOURIYAVONG, DoW, MPWT*
4th Seminar (Luangprabang Province) February 24, 2014 (Mon), February 25 (Tue) 29 Participants	The 1st day: February 24, 2014 (Mon)
	<10:40 - 11:20> Procedure of Deciding the Design Velocity at Nasa *Instructor: Ms. Moukmany VANNASY, DoW, MPWT*
	<11:20 - 12:00> Detailed Design for Riverbank Protection Works at Ban Nasa, Luangprabang Province *Instructor: Mr. Khampheiuy LEEFHUNG, DoW, MPWT*
	<13:40 - 14:10> Construction Work at Ban Nasa, Luangprabang Province *Instructor: Mr. Sombath CHAREUNPHONH, DPWT Luangprabang Province*
	<14:10 - 14:40> Construction Management *Instructor: Mr. Phimmasone SENGSOURIYAVONG, DoW, MPWT*

3.5 Monitoring, Evaluation and Maintenance for Riverbank Protection Works [Output 3]

3.5.1 Ability Improvement through the Implementation of Pilot Projects

(1) Establishing a plan for monitoring, evaluation and maintenance of the pilot projects

Plans for monitoring, evaluation and maintenance of the riverbank protection works were established. C/P officials should play the main role in monitoring. It was required to determine realistic interval and timing for monitoring so that monitoring could be continuously conducted even while JICA experts did not accompany them.

Following the monitoring methods used in Phase I such as check list, periodic photo shoot at the same time, sketch, troubleshooting, check items were properly selected according to selected protection work method.

(2) Surveying whether or not environmental impact assessment to be applied to the pilot project, application procedure for the project, etc.

Hearing investigation to environmental institutes in Bokeo Province, Luangprabang Province, Bolikhamxay Province and Vientiane Capital where the pilot projects were conducted to gather information on environmental laws, environmental protection regulation plan, etc. and to understand compliance, procedures, etc. required for environmental protection. In particular, we recognized many plans established in line with designation of World Heritage site in Luangprabang Province and understood required compliance and procedures. A survey plan when preliminary survey is required would be prepared.

C/P officials collected “Decree on Environmental Impact Assessment” and “Environmental Protection Law”, and confirmed that application was unnecessary if the construction range was less than 1 km. In addition, application was unnecessary because the construction site at Ban Souanlouang (Nasa) in Luangprabang Province was out of World heritage area.

(3) Executing monitoring and maintenance together with repair as necessary on the pilot project works

As the pilot construction works in this Project are environmentally friendly, manpower-oriented and also on a pilot basis construction, impact against natural and social environment was seemed to quite low. Therefore, monitoring activities after completion of the construction, especially monitoring period for the first rainy (flood) season just after completion is more important than that of during the construction.

1) Bokeo Province

Construction of riverbank protection works at Paoy Village, Houayxay District in Bokeo Province had been completed in the second year (May 2012). Based on the monitoring manual and plan for monitoring, evaluation and maintenance established for Paoy site as described in (1) above, monitoring was conducted by C/P officials. As a result, favorable accumulation of the sediments appeared (refer to Photo 3.5-1). On the other hands, due to rise of water in the Mekong River in the beginning of August 2012, slope protection work at around section 0+240m was damaged caused by local scouring (refer to Photo 3.5-2). Warranty for one (1) year after completion of the construction

was stipulated in the Contract. Therefore, it was possible to conduct maintenance operation up to 10% of the Contract Price so that further monitoring activities by C/P officials was conducted and also maintenance operation which was planned to be conducted in the third year.


Photo 3.5-1 Situation of Pilot Construction Site in Ban Paoy as of August 2012


Photo 3.5-2 Deformation of Slope Protection Work and Monitoring Activity by C/P Officials

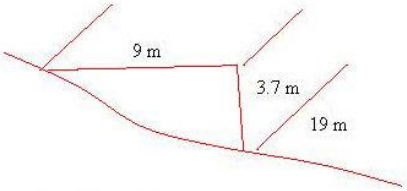
Detailed information of monitoring result by C/P officials as of December 2012 and March 2013 on damaged portion of slope protection work at around section 0+240m are as shown in Fig. 3.5-1 and Fig. 3.5-2, respectively. Based on the detailed information, maintenance operation was planned in collaboration with C/P officials and JICA experts. After that maintenance operation was carried out by the Contractor. Gabion Mattress Work was adopted as repair work based on the agreement between Technical Cooperation Project Team and the Contractor. Detailed information of monitoring result by C/P officials as of May 2013 on damaged portion of slope protection work at around section 0+240m just after completion of repair work is as shown in Fig. 3.5-3.

Detailed Information of Monitoring

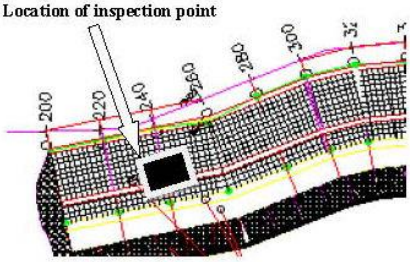
Site Name	Pa-oy	Date of Inspection	12/12/12	Inspector	Dethoudom

Condition/Photograph,

sketch



Location of inspection point



Remark:

Damage point after rainy session

Damage Records	Station	**0+240**
	layer	**Upper and middle**
	Length(m)	**20 m**
Responses	□ Urgent □ Not urgent	
Possible Counter Measure	**Possible stone work, Rensai tence work and plant willow**	

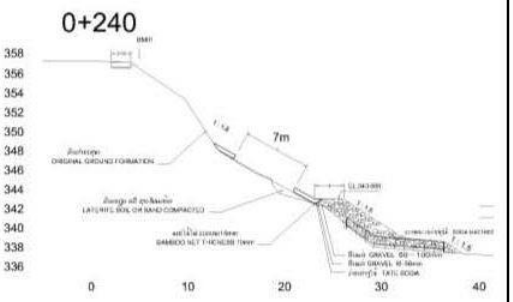
Fig. 3.5-1 Monitoring Result at Damaged Section (0+240m) at Paoy Site as of December 2012

Detailed Information of Monitoring

Site Name	pa-oy	Date of Inspection	18/03/13	Inspector	

Condition/Photograph, sketch

Cross Section



Remark:

Check more detail to repairer the damage point

Damage Records	Station	**0+240**
	layer	**Upper and middle**
	Length(m)	**20 m**
Responses	□ Urgent	□ Not urgent
Possible Counter Measure	**Possible stone work, Rensai tence work and plant willow**	

Fig. 3.5-2 Monitoring Result at Damaged Section (0+240m) at Paoy Site as of March 2013

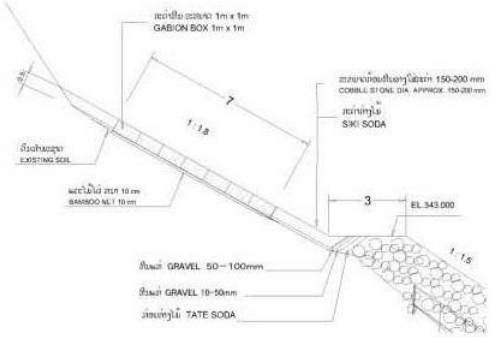
Site Name	Pa-oy	Date of Inspection	13/5/13	Inspector	Moukmany
Condition/Photograph				Cross Section	
					
Remark:				Damage Records	Station: 0+240
					layer: Upper and middle
Completed repair work by Gabion Box					Length(m): 20 m
				Responses	□ Urgent □ Not urgent
				Possible Counter Measure	Possible stonework

Fig. 3.5-3 Monitoring Result at Damaged Section (0+240m) at Paoy Site as of May 2013

In addition, Soda Drainage Work was also done for slope protection work at around section 0+360m to mitigate rainfall erosion as a part of maintenance operation (refer to Fig. 3.5-4).

Detailed Information of Monitoring

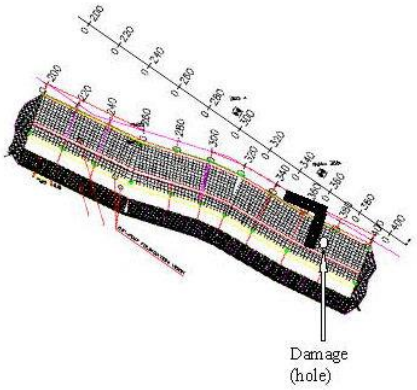
Site Name	Pa-oy	Date of Inspection	13/5/13	Inspector	Moukmany
Condition/Photograph				Plan	
					
Remark:				Damage Records	Station: 0+360
					layer: Upper and middle
Completed repair work by Soda Drainage Work					Length(m): 40 m
				Responses	□ Urgent □ Not urgent
				Possible Counter Measure	Possible stonework, Rensai tence

Fig. 3.5-4 Monitoring Result at Damaged Section (0+360m) at Paoy Site as of May 2013

On the other hand, vegetation grows steadily including baby trees of Mekong Willow which have been planted at the slope. Fig. 3.5-5 shows monitoring result on vegetation at the slope section of

riverbank protection works at Paoy Site as of May 2013.

Monitoring of Vegetation

Site Name/Area	Pa-oy	**Date**	13/5/2013	**Inspector**	Moukmany
Layer	**Upper Layer**	**Middle Layer**		**Lower Layer**	
Group	□Tree □Shrub □Grass □Others	□Tree □Shrub □Grass □Others		□Tree □Shrub □Grass □Others	
Willow	□Community □Individual □No	□Community □Individual □No		□Community □Individual □No	
Vegetation Progress	□Coverd □A little □No	□Coverd □A little □No		□Coverd □A little □No	
Photograph	 	 		 	
Remark					

Fig. 3.5-5 Monitoring Result on Vegetation at the Slope Section of Riverbank Protection Works at Paoy Site as of May 2013

In the fourth year, situation at around section 0+240m as of March 2014 is as shown in Photo 3.5-3. As Paoy site has experienced rainy season twice after completion of the construction, riverbank was tended to be stable and there was no additional damage at around section 0+240m. In addition, vegetation as represented by Mekong Willow has been favorably progressed (refer to Photo 3.5-4, 3.5-5) and riverbank at Paoy site was assessed to be kept in good condition.

Photo 3.5-3 Monitoring Result at Damaged Section (0+240m) at Paoy Site as of March 2014


Photo 3.5-4 Progress of Vegetation at the Slope at Paoy Site as of March 2014


Photo 3.5-5 Progress of Vegetation at the Slope at Paoy Site as of May 2014

2) Bolikhamxay Province

Final inspection on riverbank protection works at Pakthoay Village, Thaphabath District in Bolikhamxay Province was conducted in June 2013. After that some portions of slope protection work were damaged due to rise of water in the Mekong River and heavy rain in the beginning of August 2013. Detailed information of monitoring result by C/P officials as of August 2013 on damaged portions of slope protection work are as shown in Fig. 3.5-6 and Fig. 3.5-7.

As water level of the Mekong River become lower related to dry season in the fourth year, discussion on maintenance activity including repair work was held among three (3) parties of C/P officials (DoW and DPWT in Bolikhamxay Province), the Contractor and JICA experts in March 2014 (refer to Photo 3.5-6). As there were some remaining stone materials beside the site which were transported from the quarry site for construction and abandoned, repair work by putting these stones for reinforcement at damaged sections was agreed among three (3) parties.

ຊື່ສະຖານທີ່ ປາກທວາຍ	ວັນທີ ສຳຫຼວດ	14 / 08 / 2013	ຜູ້ສຳຫຼວດ:	ຄຳແສນ ພະຍາໄຊ
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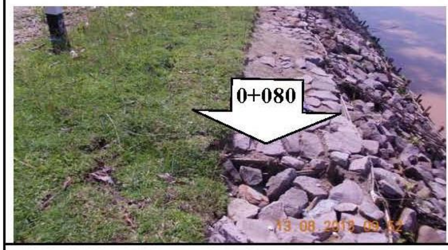

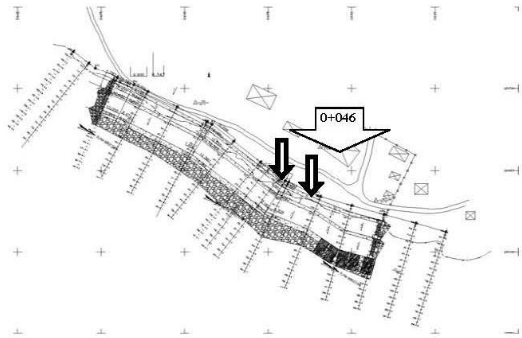

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ເກີດມີ ນ້ຳລອດພື້ນ ຢູ່ຈຸດ 0+046 ແລະ 0+080	ຈຸດທີ່ເກີດຄວາມເສຍຫາຍ / ການສ້ອມແປງ	0+046 ແລະ 0+080
	ລາຄາການກໍ່ສ້າງ	
	No.	

Fig. 3.5-6 Monitoring Result at Damaged Section (0+046m, 0+080m) at Pakthoay Site as of August 2013

ຊື່ສະຖານທີ່ ປາກທວາຍ	ວັນທີ ສຳຫຼວດ	14 / 08 / 2013	ຜູ້ສຳຫຼວດ	ຄຳແສນ ພະຍາໄຊ
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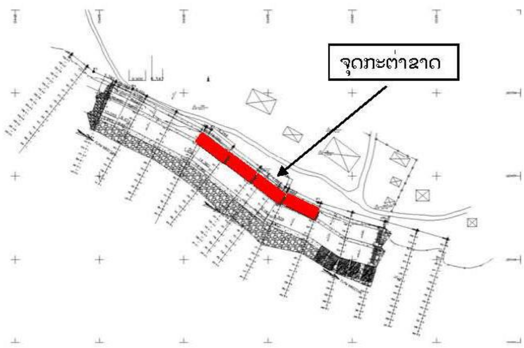

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	ລາຄາການກໍ່ສ້າງ	
	No.	

Fig. 3.5-7 Monitoring Result at Damaged Section (0+060 to 0+160m) at Pakthoay Site as of August 2013


Photo 3.5-6 Discussion among Three Parties Regarding Repair Work at Pakthoay Site as of March 2014

Later on C/P officials and JICA experts visited the site for confirmation together with Terminal Joint Evaluation Team in May 2014 and found the completion of repir work (refer to Photo 3.5-7). There were no additional damage at the slope. On the other hands, favorable accumulation of the sediments and progress of vegetation were found (refer to Photo 3.5-8). It is difficult to conclude the stability of pilot construction works because it has experienced rainy season only once after completion of the construction. However, riverbank at Pakthoay site is seemed to be stable in general.


Photo 3.5-7 Monitoring Result at Damaged Section at Pakthoay Site as of May 2014


Photo 3.5-8 Progress of Vegetation at the Slope at Pakthoay Site as of May 2014

3.5.2 Ability Improvement through Developing and Updating Manuals

In order to revise manual, existing riverbank protection works such as revetment works and groyne works were studied in Bokeo Province and Vientiane Capital. After that, based on the manual for monitoring and manual for operation/maintenance prepared in Phase I, manual for monitoring, evaluation and maintenance was prepared by adding knowledge and know-how acquired through the implementation of pilot projects in Bokeo Province and Bolikhamxay Province. The revision work was done in collaboration with C/P officials and JICA experts.

Final edition of the manual which was translated into Lao by C/P officials with the cooperation of professors of National University of Laos (NUOL) is attached to annex of this report.

3.5.3 Improve Organizational Ability through Training Instructors and Establishing Training System by Providing Trainings and Seminars

Lecture programs on "Monitoring, Evaluation and Maintenance of Riverbank Protection Works" were presented for the second, third and fourth training sessions and seminars as shown in Table 3.5-1 in association with revision of monitoring, evaluation and maintenance manual for further understanding of monitoring and maintenance field by C/P officials.

Table 3.5-1 Lecture Programs and Instructors on "Monitoring/Evaluation/Maintenance of Riverbank Protection Works"

2nd Seminar (Bokeo Province) February 2, 2012 (Thu), February 3, 2012 (Fri) 40 Participants	The 1st day: February 2, 2012 (Thu)
	<14:40 – 15:20> Monitoring, Evaluation and Maintenance of Riverbank Protection Works *Instructor: Mr. Deth Oudom HEUANMISAVATH, DPWT Bokeo Province*
3rd Seminar (Bolikhamxay Province) March 28, 2013 (Thu), March 29, 2013 (Fri) 35 Participants	The 1st day: March 28, 2013 (Thu)
	<15:10 – 16:00> Monitoring, Evaluation and Maintenance of Riverbank Protection Works *Instructor: Mr. Deth Oudom HEUANMISAVATH, DPWT Bokeo Province*
4th Seminar (Luangprabang Province) February 24, 2014 (Mon), February 25 (Tue) 29 Participants	The 1st day: February 24, 2014 (Mon)
	<14:40 - 15:00> Monitoring, Evaluation and Maintenance of Riverbank Protection Works at Ban Paoy, Bokeo Province *Instructor: Mr. Deth Oudom HEUANMISAVATH, DPWT Bokeo Province*
	<15:20 - 15:40> Monitoring, Evaluation and Maintenance of Riverbank Protection Works at Ban Pakthoay, Bolikhamxay Province *Instructor: Mr. Khamsene PHAGAXAY, DPWT Bolikhamxay Province*

3.6 Acquire the Wider Knowledge on River Engineering that Contributes to More Effective and Efficient Riverbank Protection Measures [Output 4]

3.6.1 Acquire the Knowledge in Lao

During the project period, C/P officials mainly acquired their knowledge on river engineering field mainly via OJT, short test and short paper, etc. In addition, C/P officials were encouraged to participate periodical study sessions which has been held by JICA expert/ Planning Advisor to Cabinet Office of MPWT and also other seminars related to river engineering field (e.g., IDI seminar).

Furthermore, lecture programs on "River Engineering and River Management" were presented for the first, second and fourth training sessions and seminars as shown in Table 3.6-1 for further understanding of river engineering/ river management field by C/P officials.

Table 3.6-1 Lecture Programs and Instructors on "River Engineering and River Management"

1st Seminar (Vientiane Capital) March 2, 2011 (Wed), March 3, 2011 (Thu) 37 Participants	The 2nd day: March 3, 2011 (Thu) <14:10 – 15:00> Necessity of Sediment Hydraulics for Designing River Bank Protection Works *Instructor: Dr. Hideki OTSUKI, Vice Chief Advisor* <15:20 – 16:10> Introduction to Soda Mattress *Instructor: Dr. Rokuro KOBAYASHI, Expert on River Engineering/ Riverbank Protection Planning & Design/ Topographic Survey*
2nd Seminar (Bokeo Province) February 2, 2012 (Thu), February 3, 2012 (Fri) 40 Participants	The 1st day: February 2, 2012 (Thu) <10:00 – 10:40> River Restoration in Japan (Outcome of Training in Japan) *Instructor: Mr. Som Ock MANICHANH, DPWT Bokeo Province*
4th Seminar (Luangprabang Province) February 24, 2014 (Mon), February 25 (Tue) 29 Participants	The 1st day: February 24, 2014 (Mon) <09:30 - 10:20> River Management, Japanese Experience and Prospect in Lao P.D.R. *Instructor: Mr. Tatsuo HAMAGUCHI, Advisor on River Administration*

3.6.2 Counterpart Training in Japan

Technical Cooperation Projects, which optimally combine the "Dispatch of Experts", "Acceptance of Training Participants" and/or "Provision of Equipment", are the core operations of JICA's Technical Cooperation. Regarding the acceptance of training participants for this Project, training courses were held in Japan for three (3) times in total during the project period (refer to 2.2.2 of Chapter 2).

The objective of "Counterpart Training Course on "Riverbank Protection Works Phase II" is as follows;

1. Through examples on site, to learn and enrich their understanding of current river management including riverbank protection measures carried out by Japanese Government and local communities, which will allow participants to acquire basic skills to undertake survey, planning, design, construction and maintenance of riverbank protection measures, at the same time to nurture their capacity to apply in their local environment.
2. To acquire correct knowledge related to the Japanese traditional river work techniques and clarify the intention of transferring the techniques to Lao P.D.R., which allow participants to foresee concerns in applying them to local environment.
3. To develop reports to utilize knowledge and skills gained through this training for the future development of Lao P.D.R.

During their stay in Japan for about two (2) weeks, trainees received total of 22 lecture courses and practical trainings. Trainees also visited the Fuji River System (Yamanashi Prefecture), Yodogawa River System (Kyoto and Osaka Prefectures) and Shinano River System (Niigata Prefecture) to learn and enrich their understanding of current river management including riverbank protection measures.

Photo 3.6-1 The Lecture Scene on River Management in Japan [3rd Batch]


Photo 3.6-2 The Lecture Scene on Mechanism of Riverbank Failure and Knowledge on Soil Mechanics [2nd and 3rd Batch]



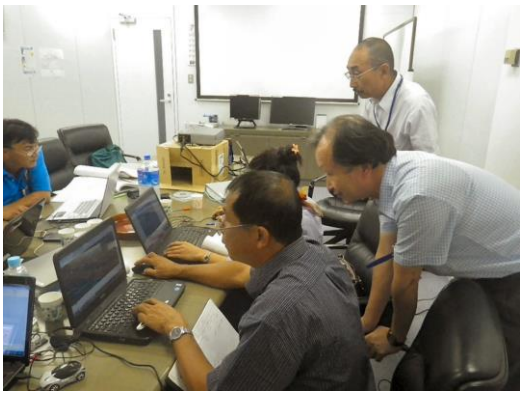

Photo 3.6-3 Practical Training on Design of Riverbank Protection Works [1st, 2nd and 3rd Batch]

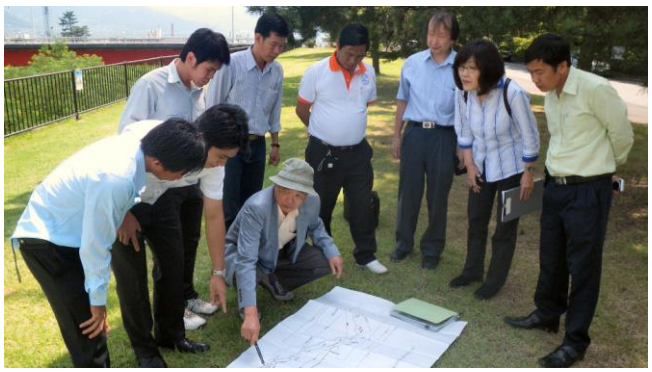

Photo 3.6-4 Trainees received on-site orientation on "Manriki Bayashi" (Flood Disaster Prevention Forest) in Fuefuki River (tributary of Fuji River) [1st Batch]

Photo 3.6-5 Trainees received on-site orientation on "Seigyu" (Skeleton Work) [1st Batch]

Note: Skeleton work called "Seigyu" in Japanese is a traditional river work in Japan. Skeleton work is a kind of permeable groyne which has the origin in Fuji River and used for many rapid streams in Japan.

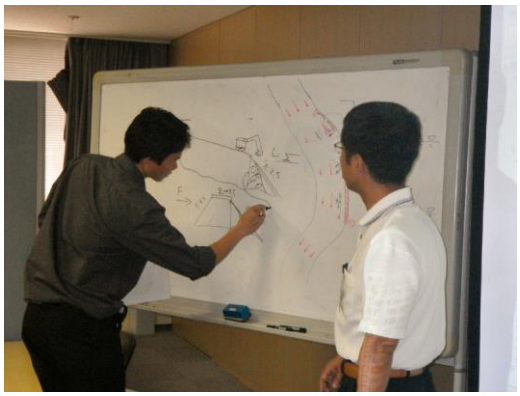

Photo 3.6-6 The Lecture Scene on Traditional River Works in Japan [2nd Batch]

Photo 3.6-7 Trainees Received an Orientation on the History of Yodo River System and River Improvement at Scenic Sites [3rd Batch]


Photo 3.6-8 Trainees Received On-site Orientation on the History of Yodo River System and Approach to River Management [2nd Batch]

Photo 3.6-9 Trainees received on-site orientation on "Yasuragi Levee" (levee with very mild slope as a water amenity facility) in the downstream of Shinano River [1st Batch]


Photo 3.6-10 Trainees Received On-site Orientation on Sustainable Soda Material Supply System [2nd and 3rd Batch]

Photo 3.6-11 Trainees Visited Construction Site of Soda Method (Soda Hurdle Work) and Pile Groyne Work in Niigata Prefecture [3rd Batch]

Photo 3.6-12 Trainees received an orientation on Ohkouzu Diversion Channel at Shinano River Ohkouzu Museum [1st Batch]

Photo 3.6-13 Trainees Visited Assembly Yard of Soda Mattresses which are Installed as a Basement of Offshore Dike in Niigata Coast [2nd Batch]

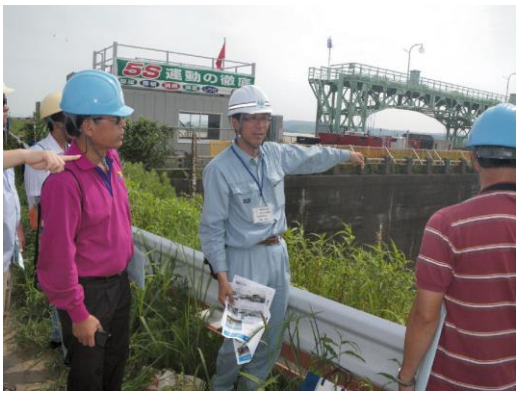

Photo 3.6-14 Trainees Received On-site Orientation on Movable Weir (Left: Old, Right: New) at Ohkouzu Diversion Channel of Shinano River [2nd Batch]

Photo 3.6-15 Trainees Presented Their Action Plan [1st, 2nd and 3rd Batch]

Photo 3.6-16 Certificate Hand-over Ceremony [1st, 2nd and 3rd Batch]

Photo 3.6-17 A Ceremonial Photograph after the Closing [1st, 2nd and 3rd Batch]

3.7 Other Activities

3.7.1 Lecture Course at Savannakhet University

As creating a framework for fostering human resources with advanced knowledge and technology contributing to industrial development is an urgent issue in Lao P.D.R., JICA has dispatched "Advisor to Savannakhet University for Development of Industrial Human Resource" since November 2012 and support fostering human resources in southern region of Lao P.D.R.

Savannakhet University (SKU) was established as a fourth university in Lao P.D.R. in October 2009. Currently, SKU has three (3) faculties, such as Faculty of Agriculture and Environment, Faculty of Linguistics and Humanity and Faculty of Business Administration. SKU aims to establish Faculty of Engineering in the future. Dr. Hideki OTSUKI, Vice Chief Advisor of consultant team organized by JICA for the Project, was invited as a lecturer to hold a special lecture on February 25, 2013. Objectives of lecture were i) educational campaign on engineering field for students of SKU, ii) dissemination of the Project activity and intend to enlarge the Project outcome. Special lecture held at second auditorium of SKU was very well attended with more than 70 participants despite the day was first day for students.

As SKU offered to hold a lecture once again regarding traditional work methods as an environmentally-friendly riverbank protection measures next year, second lecture was held by Dr. OTUKI at SKU on May 13, 2014. In total 87 participants attended, who were mostly students majoring in environmental science.


Photo 3.7-1 The Lecture Scene at Savannakhet University in February 2013


Photo 3.7-2 The Lecture Scene at Savannakhet University in May 2014

3.7.2 Public Relations of the Project

During the implementation of this Project, effective public relations aiming for accurate understanding on significance of this technical cooperation, contents of project activities and its output, were attempted to the people of all levels in Lao P.D.R. and Japan.

(1) Signboards for pilot construction works

Signboards for pilot construction works were installed at the construction sites in three (3) provinces for local residents. Descriptions were written in both Lao and English. Furthermore these were designed to visually-apparent signboard because it may be difficult for general public to understand the outcome of technical cooperation for disaster prevention.


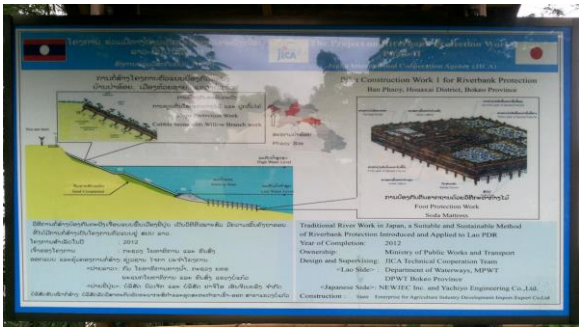

Photo 3.7-3 Signboard Installed at Paoy Site in Bokeo Province


Photo 3.7-4 Signboard Installed at Pakthoay Site in Bolikhamxay Province


Photo 3.7-5 Signboard Installed at Souanlouang (Nasa) Site in Luangprabang Province

(2) Video, poster, etc.

Fabrication of Soda Mattress demonstrated by JICA expert for the first seminar was shot by each work process and distributed to candidate bidders who didn't know how to fabricate Soda Mattress as a DVD movie together with a bidding document.

In the fourth year, project activities were summarized and organized into a series of posters and displayed at the venues of seminar, JCC meeting and project completion ceremony, etc. to support participants' better understanding of this Project.

In addition, at the time of project completion, promotional video of pilot construction works in this Project was produced by adding post-recorded Lao narration for general public. About 20-minute video was previewed to the participants attended the project completion ceremony.

Photo 3.7-6 Posters Displayed at the Venue of Project Completion Ceremony

Photo 3.7-7 Promotional Video of Pilot Construction Works in this Project

(3) Mass media

Press reporters from newspaper companies such as Vientiane Times (English) and Vientiane Mai (Lao) and persons concerned from television/radio stations were invited to key milestones in this Project such as public kick-off meeting, seminars, JCC meetings, final inspection of pilot construction works and project completion ceremony for public relations to the people of all levels in Lao P.D.R. as much as possible.

3.8 Assessment of Competence Level Advancement of the C/P Officials for Riverbank Protection Works

3.8.1 Assessment Based on Evaluation Criteria for Level of Understanding

Grade of ability improvement of C/P officials were obtained as quantitatively as possible by comparing their level of understanding at the commencement point of the project with the level at the time when the project is completed in its fourth year through quizzes, papers, interviews, etc. The target persons were C/P officials in DoW, MPWT, DPWT of Vientiane Capital and three provinces of three (3) target group.

The results of the evaluation at the fourth year completion executed to C/P officials of MPWT and C/P officials of DPWT of Vientiane Capital and three (3) target provinces according to the evaluation criteria for level of understanding are shown in Table 3.8-1 (a), (b), respectively.

Table 3.8-1 (a) The Fourth Year Evaluation Results (MPWT)

Required Abilities	The 4th Year Evaluation	Routine Discussion, etc.	Short Test, Short Paper, Interviews	Surveys in Surrounding Provinces	Work Products	Remarks
1. Participating attitude to the Project	80	90	75	75	80	▪ C/P officials' attitude has been drastically improved.
2. Basic knowledge on hydrology, hydraulics, and river engineering	65	70	55	—	70	▪ Although C/P officials' ability has been partly improved, further effort is expected.
3. On-site practical abilities	75	75	Unexcuted	75	75	▪ C/P officials have taken their initiative in thinking and acting.
Required Abilities	**Baseline Evaluation**	**Routine Discussion, etc.**	**Short Test, Short Paper, Interviews**	**Responses during the OJT**	**Work Products**	**Remarks**
4. Ability in Design	75	75	Unexcuted	—	75	▪ No problem including the operation of CAD software.
5. Ability in River Survey	80	75	—	—	80	▪ C/P officials have been able to conduct topographic survey, bathymetric survey, etc.
6. Ability in Monitoring	75	75	Unexcuted	—	75	▪ C/P officials understood well about the importance and how to do it.

7. Ability in Maintenance	60	60	Unexcuted	―	60	▪ Long-term maintainance after termination of warrantee period is an issue
Required Abilities	**Baseline Evaluation**	**Routine Discussion, etc.**	**Responses at the Construction Site**	**Responses during the OJT**	**Work Products**	**Remarks**
8. Ability in Construction Supervision*	80	75	80	80	80	▪ Getting further on-site experience is expected.

* Target period of baseline evaluation for the ability in construction supervision was set as the term from November 2011 to February 2012.

Table 3.8-1 (b) The Fourth Year Evaluation Results (DPWT)

Required Abilities	**The 4th Year Evaluation**	**Routine Discussion, etc.**	**Short Test, Short Paper, Interviews**	**Surveys in Surrounding Provinces**	**Work Products**	**Remarks**
1. Participating attitude to the Project	75	80	70	80	75	▪ C/P officials' attitude has been drastically improved.
2. Basic knowledge on hydrology, hydraulics, and river engineering	60	65	50	―	60	▪ Although C/P officials' ability has been partly improved, further effort is expected.
3. On-site practical abilities	80	80	Unexcuted	80	75	▪ C/P officials have taken their initiative in thinking and acting.
Required Abilities	**Baseline Evaluation**	**Routine Discussion, etc.**	**Short Test, Short Paper, Interviews**	**Responses during the OJT**	**Work Products**	**Remarks**
4. Ability in Design	75	75	Unexcuted	―	75	▪ Bit difficulty in operating CAD software was found.
5. Ability in River Survey	80	80	―	―	80	▪ C/P officials have been able to conduct topographic survey, bathymetric survey, etc.
6. Ability in Monitoring	80	75	Unexcuted	―	80	▪ C/P officials periodically implemented monitoring.

7. Ability in Maintenance	65	65	Unexcuted	—	65	▪ Long-term maintainance after termination of warrantee period is an issue.
Required Abilities	**Baseline Evaluation**	**Routine Discussion, etc.**	**Responses at the Construction Site**	**Responses during the OJT**	**Work Products**	**Remarks**
8. Ability in Construction Supervision*	75	70	80	80	75	▪ Getting further on-site experience is expected.

* Target period of baseline evaluation for the ability in construction supervision was set as the term from November 2011 to February 2012.

Therefore, overall result from the baseline evaluation until the fourth year evaluation for C/P officials of MPWT and C/P officials of DPWT of Vientiane Capital and three (3) target provinces are shown in Table 3.8-2 (a), (b), respectively.

Table 3.8-2 (a) Overall Result of Evaluation for Level of Understanding (MPWT)

Required Abilities	**2010.11～ 2011.2 (Baseline)**	**2011.5 (at the 1st year completion)**	**2012.5 (at the 2nd year completion)**	**2013.5 (at the 3rd year completion)**	**2014.5 (at the 4th year completion)**
1. Participating attitude to the Project	20	25	50	65	80
2. Basic knowledge on hydrology, hydraulics, and river engineering	17.5	22.5	35	50	65
3. On-site practical abilities	10	25	45	55	75
4. Ability in Design	5	25	45	55	75
5. Ability in River Survey	10	50	60	65	80
6. Ability in Monitoring	5	5	25	50	75
7. Ability in Maintenance	5	5	15	35	60
8. Ability in Construction Supervision*	47.5	N.A.	55	65	80

* Target period of baseline evaluation for the ability in construction supervision was set as the term from November 2011 to February 2012.

Table 3.8-2 (b) Overall Result of Evaluation for Level of Understanding (DPWT)

Required Abilities	2010.11～2011.2 (Baseline)	2011.5 (at the 1st year completion)	2012.5 (at the 2nd year completion)	2013.5 (at the 3rd year completion)	2014.5 (at the 4th year completion)
1. Participating attitude to the Project	20	20	40	50	75
2. Basic knowledge on hydrology, hydraulics, and river engineering	10	12.5	25	40	60
3. On-site practical abilities	10	50	55	60	80
4. Ability in Design	10	25	50	55	75
5. Ability in River Survey	25	50	60	65	80
6. Ability in Monitoring	0	0	40	55	80
7. Ability in Maintenance	5	5	15	40	65
8. Ability in Construction Supervision*	37.5	N.A.	50	62	75

* Target period of baseline evaluation for the ability in construction supervision was set as the term from November 2011 to February 2012.

As a result, both C/P officials of MPWT and C/P officials of DPWT of Vientiane Capital and three (3) target provinces didn't break through the target score of 75 points at two (2) items as follows.

2. Basic knowledge on hydrology, hydraulics, and river engineering
7. Ability in Maintenance

However, it is revealed that all scores of eight (8) items, which are required for the implementation of riverbank protection measures, have been significantly increased in number from the initial scores. That means C/P officials' required abilities have been drastically improved in all stages through four-year project activitities.

3.8.2 Assessment for the Achievement of Output

Based on the assessment as described in 3.8.1, achievement of four (4) output at the time of project completion were also assessed. As a result, three (3) output have been achieved as shown in Table 3.8-3.

Table 3.8-3 Assessment for the Achievement of Output

Output	Objectively Verifiable Indicators	Required Abilities	Final Score (at the 4th year completion)	Assessment
1) Capacity of the Staff on survey and planning for riverbank protection works is improved.	All the C/P staff scores 75 points when the Japanese experts evaluate abilities related to the survey and planning technique on the riverbank protection through OJT.	1. Participating attitude to the Project	(MPWT) 80 (DPWT) 75	Achieved
		3. On-site practical abilities	(MPWT) 75 (DPWT) 80	
		5. Ability in River Survey	(MPWT) 80 (DPWT) 80	
2) Capacity of the Staff on design and construction for riverbank protection works is improved.	All the C/P staff scores 75 points when the Japanese experts evaluate abilities related to the design and construction on the riverbank protection through OJT.	1. Participating attitude to the Project	(MPWT) 80 (DPWT) 75	Achieved
		3. On-site practical abilities	(MPWT) 75 (DPWT) 80	
		4. Ability in Design	(MPWT) 75 (DPWT) 75	
		8. Ability in Construction Supervision	(MPWT) 80 (DPWT) 75	
3) Capacity of the Staff on monitoring, maintenance and evaluation for riverbank protection works is improved.	All the C/P staff scores 75 points when the Japanese experts evaluate abilities related to the monitoring, evaluation and maintenance on the riverbank protection through OJT.	1. Participating attitude to the Project	(MPWT) 80 (DPWT) 75	Achieved
		3. On-site practical abilities	(MPWT) 75 (DPWT) 80	
		6. Ability in Monitoring	(MPWT) 75 (DPWT) 80	
		7. Ability in Maintenance	(MPWT) 60 (DPWT) 65	
4) The Staff acquire the wider knowledge on river engineering that contributes to more effective and efficient riverbank protection measures.	All the C/P staff scores 75 points when the Japanese experts evaluate abilities related to the river management and river engineering on the riverbank protection through OJT.	1. Participating attitude to the Project	(MPWT) 80 (DPWT) 75	Expected More Effort
		2. Basic knowledge on hydrology, hydraulics, and river engineering	(MPWT) 65 (DPWT) 60	

Comments for each output are as follows.

[Output 1] Capacity of the Staff on survey and planning for riverbank protection works is improved. : Achieved

Important achievements

- C/P officials have understood how to proceed with survey and select priority sites.
- C/P officials are able to produce reports to the relevant organizations to facilitate a project.

The remaining areas that need to be further improved

- Selection of an appropriate construction method(s) requires extensive experience. Further

technical knowledge and experience will be expected.

[Output 2] Capacity of the Staff on design and construction for riverbank protection works is improved. : Achieved

Important achievements

- C/P officials are able to instruct the surveyors the scope of survey and check the results of survey.
- C/P officials are able to measure necessary parameters such as velocity, use such a parameter in designing and make drawings using CAD software.
- C/P officials are able to estimate costs based on the drawings and prepare bidding documents.
- C/P officials have understood different, traditional work methods and their work flows and they are able to guide and supervise contractors.

The remaining areas that need to be further improved

- Instruction and supervision of boring work needs more expertise.

[Output 3] Capacity of the Staff on monitoring, maintenance and evaluation for riverbank protection works is improved. : Achieved

Important achievements

- C/P officials have gained good understanding of monitoring and they are able to conduct periodical monitoring in accordance with the manual.
- Based on the results of monitoring, C/P officials are able to plan and implement repair work.

The remaining areas that need to be further improved

- All the repair works were done within the warrantee period and the contractor provided the cost for repair work. C/P officials have not experienced repair work after the termination of contract period.

[Output 4] The Staff acquire the wider knowledge on river engineering that contributes to more effective and efficient riverbank protection measures. : Expected More Effort

Important achievements

- C/P officials have improved their knowledge necessary for survey, plan and design of similar projects.

The remaining areas that need to be further improved

- The knowledge that the experts transferred to the C/P officials is only relative to similar projects. The C/P officials need to gain more theoretical knowledge on hydrology and river engineering.

3.9 Project Completion Ceremony

JICA experts and C/P officials held the project completion ceremony on August 15, 2014 at Vientiane Capital including the reporting session on the technical cooperation outputs obtained throughout the Project. On top of the officials representing the target group, officials representing regional/provincial Department of Public Works and Transport and officials from other related institutions of Lao P.D.R. and related delegates from JICA were were invited. Related materials regarding project completion ceremony are as shown in Appendix-4.

On behalf of H.E. Mr. Bounchanh SINTHAVONG, Minister of MPWT, Mr. Math SOUNMALA, Director General of Planning and Cooperation of MPWT was appointed as the chairperson. In total 29 participants attended from Lao side including 13 participants from MPWT. Participants from MPWT except the chairperson were Mr. Houngla SENGMUANG, Director General and other nine (9) officials from DoW, one (1) official from Department of Planning and Cooperation and one (1) official from Department of Roads. Other participants attended from Lao side, who were one (1) official from the Ministry of Planning and Investment, two (2) officials from the Ministry of Natural Resources and Environment (MONRE), 10 officials from provincial DPWTs (Bokeo Province: 3, Bolikhamxay Province: 3, Luangprabang Province: 3, Vientiane Capital: 1), one (1) official from Mekong River Comission, one (1) professor from National University of Laos (NUOL) and one (1) director general from local contractor implemented pilot construction works in Luangprabang Province.

On the other hand, in total five (5) participants attended from Japanese side, who were, three (3) officials from JICA Laos office and two (2) JICA experts delegated for the project. Therefore in total 35 participants including interpreter attended the ceremony.

Photo 3.9-1 Project Completion Ceremony on August 15, 2014

Prior to the repoting session, a keynote speech by the chairperson and opening speech by Mr. Koichi TAKEI, Chief Representative of JICA Laos office were given, and then led to the project activity report for four years presented by Mr. Souksavanh THITHAVONG, the Project Manager of Lao side. After that Mr. Taketoshi MATSUNAGA, Chief Advisor of JICA expert team explained about evaluation results for the level of understanding of C/P officials as well as assessment for the achievement of output.

In addition, promotion video of pilot construction works in this Project as described in 3.7.2 (2) was previewed and a series of manuals, which is another impotant output of this Project as well as pilot construction works, was distributed to the participants. Distributed three (3) manuals (Lao version) were

final edition as follows.

(1) Manual for survey and planning on riverbank protection works

(2) Manual for design, cost estimation and construction on riverbank protection works

(3) Manual for monitoring, evaluation and maintenance on riverbank protection works

Photo 3.9-2 Distributed Manuals at the Project Completion Ceremony

Photo 3.9-3 A Ceremonial Photograph at the Project Completion Ceremony

4 INGENUITY AND LESSONS LEARNED FROM THE PROJECT IMPLEMENTATION/OPERATION

Ingenuities through the project implementation and lessons learned from the project operation are summarized as follows.

(1) Ingenuities

1) Collaboration between pilot construction work in this Project and construction work by Lao side own budget

- As of the first year, candidate site for the second pilot project in Bolikhamxay Province was not yet fixed to Pakthoay village, however, it was found that a series of groynes was planned to be installed just upstream of candidate site at Pakthoay village by Lao side own budget. After that candidate site for second pilot project was desided to Pakthoay village through the confirmation study implemented in the second year. On the other hand, Lao side installed a series of groynes as scheduled. As a result, complex facility using traditional work methods such as Riprap Groyne Work (upstream) and Revetment Work using Soda method (downstream) which was installed as pilot construction work in this Project, was completed in the third year.
- Although the effectiveness of complex facility shall be studied carefully through further monitoring, arrangement of each facility is favorable as follows.

  Downstream: Revetment was installed to protect in front of important facilities such as Pakthoay Temple.

  Upstream: A series of groynes is installed to protect riverbank from the direct attack of the river flow by reducing flow velocity and changing the flow direction.
- It was quite difficult to combine upstream component of complex facility into the second pilot construction work in this Project due to the constraint of budget. However, preliminaly evaluating on-going projects financed by Lao side own budget and collaborating with them to enhance the significance and/or impact of pilot construction work in this Project as well as encourage Lao side's ownership.

2) Encourage C/P officials' participation in project activities those were carried out in multiple prefectures

- C/P officials of provincial DPWTs were originally allocated to implement a pilot project in their home province. In addition C/P officials of DoW, MPWT were also individually allocated for the implementation of pilot project in each province. Therefore it was concerned that whether each C/P official would experience a series of project acrivities for the pilot project implementation only one time even though three (3) pilot projects were to be implemented in this Project.
- Considering the above-mentioned situation, encourage C/P officials' participation in not only the project activities in their home province but also those in other provinces for more effective and efficient technical transfer. For example, C/P officials of DPWT Luangprabang Province attended the project activities those were carried out for the pilot project in Bokeo Province after getting approval through the preliminaly discussion with Lao side.

(2) Lessons learned

1) Regarding bidding for pilot construction work

- Open competitive bidding was adopted as bid type and the lowest-price bid was applied as a successful bidder for the first pilot construction work in Bokeo Province. However, the successful bidder's capability for construction was not sufficient to conduct riverbank protection works.
- Based on this lesson learned, overall evaluation bidding was adopted for the second and third pilot construction works in Bolikhamxay Province and Luangprabang Province.

2) Regarding framework for supervising pilot construction work

- Not C/P officials from DPWT Bokeo Province but C/P officials from DoW, MPWT were assigned as construction supervisors for the first pilot construction work in Bokeo Province. However, construction management by C/P officials from DoW, MPWT was not enough because it was difficult for dispatched officials from Vientiane Capital to be stationed at the site on a full-time basis during construction period. Based on this lesson learned, C/P officials from provincial DPWT shall be assigned as construction supervisors for the second and third pilot construction works.
- From technical viewpoint, spreading depth of filling and its compaction were not appropriate for earth works at the slope. Also there is concern that penetration depth of wooden piles for cobble stone with Soda works was not enough for stabilization of the slope. Based on these lessons learned, inspection and supervision of construction works by construction supervisors shall be conducted strictly to satisfy technical specifications for the future construction work.
- Encourage C/P officials to instruct the contractor not to neglect safety measures for local labors.

3) Regarding replacement and/or withdrawal of C/P officials

- There was concern that a few developing human resources assigned to the Project have been lost even within the project period due to unexpected replacement and/or withdrawal of C/P officials. It was expected from Japanese side that replacement and/or withdrawal of C/P officials by private reasons and so forth is not allowed any more by Lao side. Even if legitimate problem is occurred to C/P officials, replacement by appropriate successor is strongly requested to achieve the project purpose.

5 RECOMMENDATION FOR FUTURE RIVERBANK PROTECTION MEASURES IN LAO P.D.R.

For future riverbank protection measures in Lao P.D.R., recommendations are summarized as follows.

(1) Improvement of critical issues

Based on analysis for factors and underlying causes (refer to Fig. 1.5-1) of three (3) critical issues as results of Phase I, basic policies of this Project and countermeasures (refer to Table 1.6-1) are provided to address the above-mentioned issues and factors as shown in Table 1.6-1.

Improvement substances of "critical isssues" by means of the implementation of countermeasures through four-year project activities are as follows.

1) Sustainability of riverbank protection work project is not sufficient **[Drastically Improved]**

- Ability on riverbank protection work planning was remarkably improved through five (5) opotunities in total on compilation of plans for pilot projects in three (3) provinces and those for future implementation of riverbank protection work in two (2) neighbor provinces such as Khammouane Province and Oudomxay Province.
- Construction technique (skill) of provincial engineers was improved through the implementation of pilot projects in three (3) provinces.
- Foundation for sustainable implementation of rivebank protection work was developed through the formulation of manuals on planning, construction and cost estimation which were seemed to be insufficient in the past.
- Although establishment of production system on special tools for riverbank protection work was not achieved, possibility of on-site production on special tools was confirmed.

2) Capacity of Bank Protection and Flood Control Division, Department of Waterways, Ministry of Public Works and Transport is not enough to carry out what they are required **[Drastically Improved]**

- Knowledge and experience in all stages of the implementation of riverbank protection work such as survey/planning, design/cost estimation/construction and monitoring/evaluation/maintenance was acquired by C/P officials especially young engineers of BPFCD, DoW through the Project.
- Foundation as an instructor was cultivated to C/P officials through the development of training materials and its presentation at the seminars which were conducted four (4) times in total and formulation of action plan during their participation of counterpart trainings in Japan which were conducted three (3) times in total.
- Edification and public relation on activities/business of BPFCD, DoW mainly based on the activities through this Project to inside/outside the organization, was accomplished.

3) It is concerned that implementation of riverbank protection works like symptomatic therapy approach will cause adverse effect on both upstream and downstream as well as the other side of the river
[Partly Improved]

- Knowledge on river engineering/river planning, hydraulics and hydrology was developed and also learned how to pay attention to the riverbank erosion countermeasures from the technical viewpoint.

(2) Toward achieving overall goal

Based on "Assessment for the Achievement of Output" as described in 3.8.2 of Chapter 3 and "Improvement of critical issues" as described in (1) above, recommendations toward achieving overall goal are summarized as follows.

1) Continuation of riverbank protection work in the target area (Vientiane Captital, Bokeo Province, Bolikhamxay Province and Luangprabang Province) with traditional work methods

- Extention works by traditional work method was planned at the downstream of Paoy site in Bokeo Province, however, it didn't fulfill during the implementation of this Project. To ensure earliest possible implementation of the said extention works is highly recommended.
- In other target area, it is expected to take strong initiative by Lao side under the leadership of C/P officials to implement riverbank protection work not to terminate technical transfer on traditional work methods.
- Selection of appropriate work methods requires extensive experience, therefore it is a difficult issue even for Japanese veteran engineer. Therefore it is advisable to cultivate further technical knowledge and experience for judgement by trial-and-error solution through the continuation of riverbank protection work.

2) Adoption of traditional work methods for riverbank protection work in other provinces than the target area

- As a part of project activities, prioritization studies on riverbank erosion countermeasures were conducted for Khammouane Province and Oudomxay Province in this Project. In addition candidate riverbank protection work method was examined for prioritized site in Oudomxay Province. For the implementation of riverbank protection work in other provinces than the target area with traditional work methods, it is expected for budget allocation by Lao side as early as possible and establishment of technical leadership.

3) Appropreate maintenance for existing construction sites where riverbank protection works with traditional work methods were installed

- It is expected that newly installed rivebank protection works with traditional work methods in this Project as well as those in Development Study and Phase I are to be appropriately maintained

by Lao side own effort. It is not necessary for replacement of traditional works by modern works such as concrete revetment when the stability of rivebank are confirmed. For example, riverbank has been drastically improved and kept in good condition at Paoy site in Bokeo Province since 2012 even if the slope protection work doesn't cover up to the top of riverbank.

- All the repair works in this Project were done within the warrantee period (one year) by the contractor at its cost. Therefore it is desirable for GOL to allocate the budget for monitoring and maintenance after the termination of contract period from the viewpoint of sustainability.

4) Continuous employment of C/P officials

- Knowledge and experience acquired by C/P officials is a precious property which is essential for future implementation of riverbank protection works in Lao P.D.R. Therefore it is required to ensure that all the C/P officials participating in this Project from different divisions will be transferred to BPFCD in DoW, and that all the C/P officials from the DPWTs should retain in the same unit to support the implementation of riverbank protection work.

5) Further training of river engineers using developed manuals

- As a part of the project activities in Phase I, lectures on riverbank protection works (including Soda Mattress Work) and general river engineering had been carried out at Faculty of Engineering and Architecture, National University of Laos (NUOL). The scholastic evaluation (3 units) by the university lecturer based on the final test prepared by the C/P offcials had been also carried out, and the aimed regularization and unit conferment of the lecture had been realized. However, although lectures at NUOL had been continued at least for a while after the Phase I terminated, it seems not being carried out regularly at present.
- Considering the above-mentioned background, it seems an epochmaking event to conduct translation of manuals developed in this Project into Lao by C/P officials with the cooperation of NUOL before termination of this Project. Furthermore lectures at NUOL will restart using translated manuals.
- On the other hand, considering the capability of C/P officials in Phase II, fostering experts on river engineering field is an urgent issue in Lao P.D.R. For this purpose, it is essential creating a framework for fostering human resources including instructors by such means as establishment of acquirement system to get fundamental academic capability on river engineering and technical knowledge including continuation of above-mentioned lectures and enhancement of various educational training programs in Lao P.D.R. for sustainable technology transfer.
- The knowledge that JICA experts transferred to C/P officials was highly-selected one for getting through the project activities, in other words, it was still limited knowledge compared with all about river engineering, hydraulics and hydrology. Also educational foundation on mathematics, physics, etc. studied at elementaly school – junior high school – high school (in the case of Japan) is required as precondition to understand those elaborately. Therefore further development on educational foundation in Lao P.D.R. is expected.

6) Coordination of engineers on related area of expertise

- When proceeding projects on riverbank protection works, it might require expertise in which government officials in charge of river administration doesn't acquire enough such as supervision of geological survey, biodiversity survey, etc. In the light of above-mentioned situation, it is important for government officials in charge of river administration should acquire a minimum capability on those expertise as well as information sharing among them and periodical exchange information with them.
- For example, instruction to and supervision of the contractor for boring test needs more expertise for C/P officials. Therefore it is recommended asking external advisory for technical suggestion initially as well as trying to acquire further knowledge using manuals for reference.

7) Acquirement on further overseas technology

- It is suggested that government officials in charge acquire skills on the selection of work methods based on site conditions by attending oversesas training to know actual situation of construction and maintenance on various river work methods which is difficult to acquire in Lao P.D.R. and/or inviting foreign instructor to learn the function/characteristic of those work methods.

8) Improvement of river information management systems

- DoW, MPWT receives meteorological and/or hydrological data, which is essential for considering river planning and river management, from Department of Meteorology and Hydrology (DMH), Ministry of Natural Resources and Environment (MONRE) as necessary. For this purpose, agreement on information sharing including meteorological and/or hydrological data of DMH has been concluded between DoW and DMH. However concerned parties of the Project have been endured hardship and it took long time for getting meteorological and/or hydrological data from DMH, especially in early stage of the Project. Therefore, further improvement of river management systems in Lao P.D.R. is recommended; at least relevant authorities on river management such as DoW, MPWT and Waterways Administration Unit of provincial DPWT shall be able to obtain meteorological and/or hydrological data on a real time basis.

(3) Toward effective water disaster prevention measures, and effective river management

River management consists of three (3) components such as "flood control", "water utilization" and "environment". Furthermore riverbank protection works against riverbank erosion, which was a main theme for this Project, is one of the series of structural measures for "flood control" in entire river management. Therefore it is also recommended for effective water disaster prevention measures, and effective river management in Lao P.D.R. as follows.

1) Collaboration and coordination among the ministries/agencies concerned for river management

- The Law on Water Resources, which is proceeded for approval by GOL, was formulated by Department of Water Resources (DoWR), MONRE for effective water resources management including river (surface water) management. It is sure that DoW, MPWT will be further

developed by not only an organization in charge for riverbank protection measures but also an organization in charge for effective water disaster prevention, and effective river management in Lao P.D.R. in collaboration with DoWR, DMH, etc.

2) Secure an appropriate budget for river administration

- It is essential to secure budget as needed to carry out policy measures appropriately required for river administration. A budget for river administration shall include not only budget for construction of various structural measures but also budget for survey, planning and design for new facilities and monitoring/maintenance for existing facilities. Therefore it is required for securing (annual) budget for river administration appropriately and continuously under the long-term sufficient budget planning based on future visions.

3) Encourage development on hydrologic/hydraulic observation network

- It is important to estimate rainfall and discharge adequately as an external force to conduct water disaster prevention effectively and efficiently. However, the current situation of hydrologic/hydraulic observation facilities in Lao P.D.R. is not sufficient (especially in rural area). Threrefore, further development on hydrologic/hydraulic observation network in future based on the suggestion of experts in this field is expected.

4) Collaboration and coordination among the neighbor countries

- Basically river improvement works shall be couducted under the basin-wide river improvement master plan. However, the river works in the Mekong River are planned based on each surrounding country's own policy, even though the Mekong River is an international river. It is sure that above-mentioned situation doesn't lead to the benefit among basin countries of the Mekong River in future. Therefore it is expected that basin-wide river improvement master plan will be formulated as early as possible to accomplish framework formulation for river improvement works in collaboration with the neighbor countries. For this purpose, it is recommended to start discussion among not only member countries of the Mekong River Commission but also all basin countries of the Mekong River as early as possible.