JICA STUDY ON
MEKONG RIVERBANK
PROTECTION AROUND
VIENTIANE MUNICIPALITY

PROGRESS REPORT (3)

June 2003

NIKKEN Consultants, Inc.
and
NEWJEC Inc.

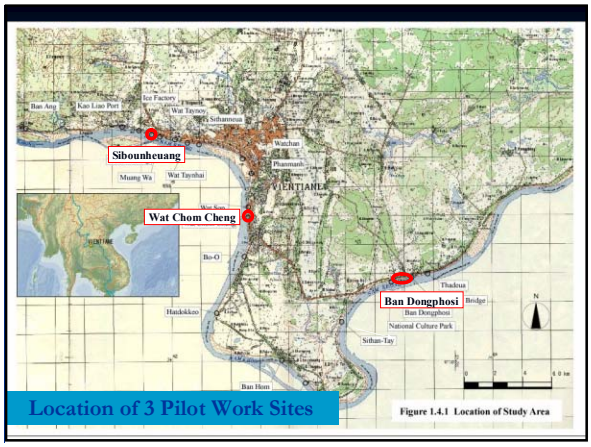
Main Contents of P/R(3) for Today's Discussion

- 1) Introduction
  - Completion of 3 Pilot Works
- 2) Execution of Pilot Works (April – May 2003)
  - Ban Dongphosi Site
  - Wat Chom Cheng Site
  - Sibounheuang Site
- 3) Monitoring of Pilot Works

1. Introduction

(1) Overall Work Schedule

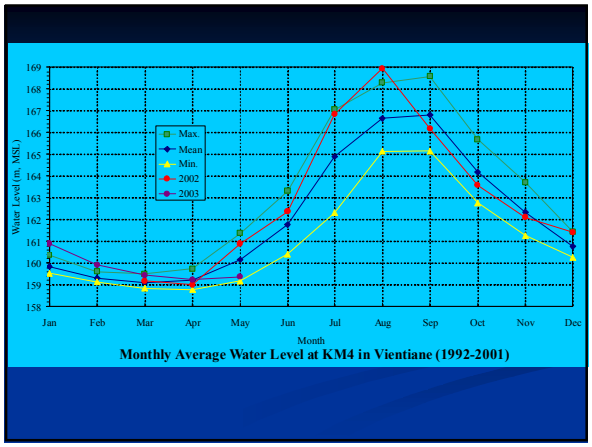
- 1st year (Dec. 2001-Mar. 2002)
  Basic study in the Study area
- 2nd year (Oct. 2002- Mar. 2003)
  Execution of pilot works
- 3rd year (Apr. 2003- Mar.2004)
  - Execution of pilot works (Apr- May 2003)
  - Monitoring of pilot works
  - Formulation of master plan (Dec.2003- Mar. 2004)
- 4th year (Nov. 2004- Mar. 2005)
  Monitoring of pilot works



Location of 3 Pilot Work Sites

(2) Completion of Pilot Works (1/2)

- Completed at 3 sites in May 2003
- Inspected by the Study Team in June 2003 (in full cooperation with MCTPC)
- Scheme of execution: Sublet contract with the Study Team for JICA Development Study (Not JICA's Grant Aid Project scheme)
- Supervision: JICA Study Team (in full cooperation with MCTPC)



Monthly Average Water Level at KM4 in Vientiane (1992-2001)

(2) Completion of Pilot Works (2/2)

- Contractor: Obayashi Corporation
  (selected by competitive bidding)
- Construction Period:
  January 2003 – May 2003 (5 months)
- Construction Cost (engineering estimate):
  approx. US$ 1,259,000
  - Ban Dongphosi: US$ 1,088,000 (approx. US$ 1,690/m)
  - Wat Chom Cheng: US$ 49,000 (approx. US$ 200/m)
  - Sibounheuang: US$ 122,000 (approx. US$ 810/m)

2. EXECUTION OF PILOT WORK AT BAN DONGPHOSI

(1) Outline

- Construction type:
  - Foundation work (Riprap work)
  - Foot protection work (Soda Mattress work)
  - Slope protection work (Cobble stone with willow branch work)
- Total length: 643 m
- After completion, willows will grow and will ***cover and grasp*** the surface of the slope.

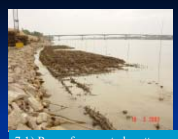
(2) Remaining Construction Work

(April 2003 – May 2003)

1) Foot Protection Works

a) Installation of Soda Mattress (66 Sheets)

- Assembled Soda mattresses are transported and submerged by putting rubble stones on them.
  - Transported by Crawler Crane to the riverbank
  - Using Crawler Crane, the mattress is placed on the river and fixed by anchors.
  - Putting rubble stones on the mattress by wire straw-basket and/or backhoe to submerge them (April- May 2003)



7-1) Row of connected mattresses

7-2) Row of connected mattresses

8-1) Putting rubble stones on mattress by wire straw-basket

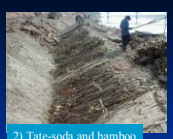
8-2) Putting rubble stones on mattress by backhoe

Workflow of Foot Protection Work
- Installation of Soda Mattress -

2) Earth Works

- Outline:
  - Filling work to construct the embankment for the basis of cobble stone with willow branch works.
- Construction Method:
  - Trimming of slope and clearance
  - Transportation of the Mekong river sand (V=45,000 m^3) by dump truck
    - material above El. 161.5 m changed from laterite to sand
  - Filling the sand by backhoe and bulldozer
  - Moisture content arrangement
  - Compaction by bulldozer and vibration roller

1) Trimming of the slope by backhoe



2) Tate-soda and bamboo net setting

3) Filling of river sand below El. 161.5m

4) Moisture content arrangement by pumping water and compaction by roller

5) Spreading and compaction by Bulldozer above El. 161.5m

6) Gravel spreading and compaction for the restoration at temporary access road

Workflow of Earth Works

2) Slope Protection Works

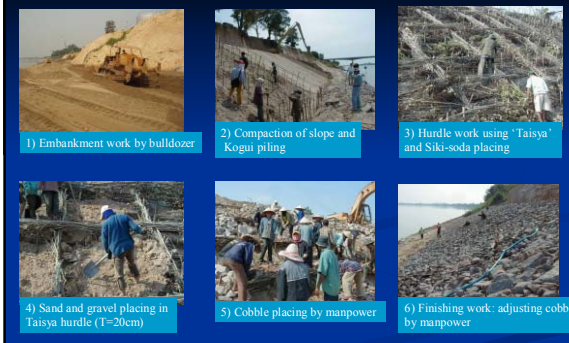
a) Cobble Stone with Willow Branch Works

- Outline:
  - The structure on the slope of sand embankment consists of:
    - Siki soda
    - Taisya (tie-twig) hurdle work
    - Willow branch placing
    - River sand & gravel placing
    - Cobble stone placing.

2) Slope Protection Works

a) Cobble Stone with Willow Branch Works

- Construction Method:
  - Compaction and furnishing of slope (A=13,700 m2)
  - Piling Kogui
  - Laying Taisya for frame fence
  - Pounding & placing of river sand, gravel and willow branch in the frame
  - Placing cobble stone (about 3,000 m3) in the frames



Workflow of Cobble Stone with Willow Branch Works

2) Slope Protection Works

b) Partial Reinforcement by Stone Covering

- Outline:
  - Additional covering riprap to reinforce completed cobble stone with willow branch works taking into account the importance of oil tanks.
  - Slope gradient 1:1.9 (L=100 m)
- Construction Method:
  - Transport crushed stone (V=1,375m^3) by dump truck
  - Placing the stone by backhoe
  - Stone adjustment by man-power

Workflow of Partial Reinforcement by Stone Covering

3. EXECUTION OF PILOT WORK AT WAT CHOM CHENG

(1) Outline

- Construction type:
  - Foot protection work (wooden pile groin work, Soda Mattress)
  - Slope protection work (wooden pile groin work)
- Test Pattern
  - Total length: 240 m
  - 6 groins (3 of them: reinforced by Soda Mattress)
  - Spacing:
    - 40 m (upstream stretch)
    - 60 m (downstream stretch)
  - Length of the groin: 20m

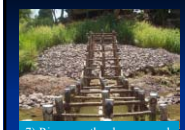
(2) Remaining Construction Work

(April 2003 – May 2003)

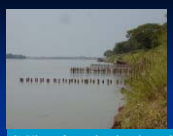
1) Groin Works

a) Log Piling

- Outline: Permeable dyke groin to reduce river flow velocity and sifting current direction offshore-wards to protect riverbank.
- Construction Method
  - 378 wooden piles (L=6 m) are driven by backhoe on barge
  - Wooden pile is connected with tie-beam (L=3.2 m).
  - Riprap is placed on the slope around connecting piles (April – May 2003)



7) Riprap on the slope around connecting piles



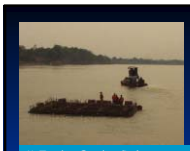
8) View of completed groin works

Workflow of Wooden Log Piling (2/2)

1) Groin Works

a) Installation of Soda Mattress (9 Sheets)

- Outline:
  - Soda mattresses are transported to the site and submerged by putting rubble stones.
  - All the work is conducted on the water.
- Construction Method:
  - Floating Soda mattress is towed by boat from Kao Liao stockyard into the site.
  - Using the boat and manpower, the mattress is placed on the river and fixed by anchors.
  - The mattress is submerged by putting rubble stones on them by a backhoe on a barge



1) Towing floating Soda mattress by boat from Kao Liao stockyard into the site

2) Placing Soda mattress at the planned position by boat and manpower

3) Putting rubble stones on mattress by backhoe on barge to submerge mattress

Workflow of Installation of Soda Mattress

4. EXECUTION OF PILOT WORK AT SIBOUNHEUANG

(1) Outline

- Construction type:
  - Foundation work (log hurdle work),
  - Foot protection work (Soda Mattress work)
  - Slope protection work for lower bank
    (Cobble stone with willow branch work)
- Total length: 156 m

(2) Remaining Construction Work

(April 2003 – May 2003)

1) Earth Works

- Outline and Method:
  - The same as that for Ban Dongphosi site fundamentally
  - The material (river sand (V=270 m^3) and laterite (V=520 m^3)) and construction equipment are transported by barges.
  - The compaction work is conducted from the backhoe on the barge.

1) River sand filling and moisture arrangement

2) Overview of sand embankment level (EL 161.9 m)

3) Laterite loading by backhoe

4) Compaction by vibration rollers and slope compaction by a backhoe

5) Filling and slope compaction by backhoe on barge

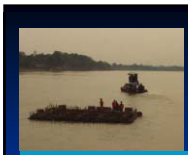
6) Check of the compaction and finishing of the embankment level

Workflow of Earth Works

2) Foot Protection Works

a) Installation of Soda Mattress (23 sheets)

- Outline and Method:
  The same as that for Wat Chom Cheng site basically



1) Towing floating Soda mattress by boat from Kao Liao stockyard into the site

2) Placing floating Soda mattress at the planned position by boat

3) Making fine adjustment by manpower

4) Connecting Soda mattresses by manpower

5) Row of connected mattresses

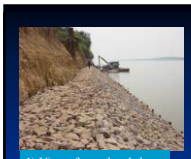
6) Putting rubble stones on mattress by backhoe on barge to submerge mattress

Workflow of Installation Soda Mattress

2) Foot Protection Works

b) Toe Rubble Deposition

- Outline
  - Done around log hurdle work and conjunction to Soda mattress to reinforce stability of earth embankment.
- Construction Method
  - Stone material (V=2,400 m3) and construction equipment transported by barges
  - Placing and filling the material by a backhoe on the barge
  - Stone adjustment by manpower


1) View of completed slope protection work


2) Stone transported from Kao Liao stockyard by barge loaded by backhoe


3) Stone placing adjustment by hand around log hurdle work


4) Stone placing adjustment by hand under water around the conjunction to Soda mattress


5) Completed toe rubble deposition

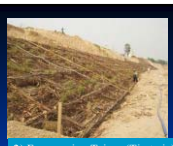
Workflow of Toe Rubble Deposition

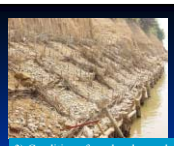
3) Slope Protection Works

a) Cobble Stone with Willow Branch Works

- Outline and Method:
  - The same as that for Ban Dongphosi site fundamentally
- Quantity
  - Crushed cobble (V=1,100m^3)
  - Siki soda, Taisya, Kogui, willow branch (A=1,100m^2)


1) Embankment of river sand


2) Frame using Taisya (Tie-twig)


3) Condition of sand and gravel placed in the frame (Taisya hurdle)


4) Cobble placing by backhoe on barge


5) Cobble adjustment by manpower


6) Completed works

Workflow of
Cobble Stone with Willow Branch Works

5 MONITORING SURVEY FOR COMPLETED PILOT WORKS

- On June 2003, the following surveys have been conducted by local contractors under the supervision by the Study Team.
  - 1) Cross-sectional survey
  - 2) velocity measurements
- Succeeding monitoring works are scheduled to be conducted periodically until January 2005.

Future Schedule

- Dec 2003 – Mar 2004: Formulation of riverbank protection Master plan

Work Schedule for Formulation of Master Plan

	2003	2004		
	December	January	February	
Original Work Schedule		IT/R		P/R(3)
Revised Work Schedule				IT/R

: Work in Lao P.D.R. , : Work in Japan
IT/R: Interim Report, P/R(3): Progress Report (3)


END

THE STUDY ON
MEKONG RIVERBANK PROTECTION
AROUND
VIENTIANE MUNICIPALITY

INTERIM REPORT

MATERIAL FOR STEERING COMMITTEE

February 25, 2004
JICA Study Team
(NIKKEN Consultants, Inc. and NEWJEC Inc.)

Scope of Interim Report

- To compile all the study result from Dec. 2001 – Feb. 2004
- Contents of IT/R
  - 1) Introduction
  - 2) Basic Study
  - 3) Execution of Pilot Works
  - 4) Monitoring
  - 5) Formulation of Master Plan
  - 6) Preparation of Manual for Riverbank Protection
  - 7) Monitoring Survey for Pilot Works
- Today's discussion is focused on item 5)

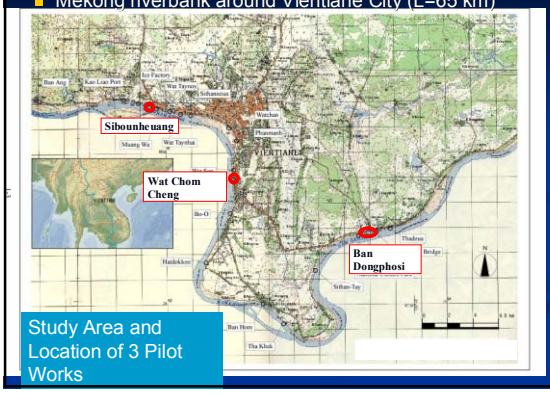
1. INTRODUCTION

(1) Objectives of the Study

- To study bank protection works adaptable to the Mekong River and sustainable in Lao P.D.R., introducing traditional river works of Japan.
- To transfer technology to the counterpart personnel through Pilot Works.
- To formulate "Bank Protection Master Plan around around Vientiane City".

(2) Study Area

- Mekong riverbank around Vientiane City (L=65 km)



Study Area and Location of 3 Pilot Works

(3) Overall Work Schedule

- 1st year (Dec. 2001-Mar. 2002): Basic study in the Study area
- 2nd year (Oct. 2002- Mar. 2003): Execution of pilot works
- 3rd year (Apr. 2003- Feb.2004)
  - Execution of pilot works (Apr- May 2003)
  - Monitoring of pilot works (June 2003 -)
  - **Formulation of Master Plan (Dec.2003- Feb. 2004) : Interim Report**
- 4th year (Nov. 2004- Mar. 2005) :Monitoring of pilot works
  - Draft Final Report & 2nd Technology Transfer Seminar : January 2005
  - Final Report: March 2005

(4) Sessions and Seminar

- Indoor session
  - Jan. 26, 2004 in MCTPC meeting room
  - presentation/discussion on the results of the Study
- Field session
  - Feb.10, 2004 at Nongheo site
  - demonstration of simple vegetation riverbank protection works by a Japanese Soda technique experts

Vientiane Times (Feb. 12, 2004) →

Willows the saviours of the riverbank

(4) Sessions and Seminar

- 2nd Technology Transfer Seminar
  - "Draft program" is prepared (refer to Appendix 2 of IT/R).
    - Date: January ??, 2005
    - Venue: Lao Plaza Hotel or Don Chan Palace Hotel (under construction)
    - Objective: to exchange technical ideas and to transfer technology on riverbank protection
    - Contents: bank protection-related themes by presenters and free discussion sessions

2. BASIC STUDY

Summary of Progress Report (1) in Mar. 2002

3. EXECUTION OF PILOT WORKS

Summary of Progress Report (2) in Mar. 2003 and Progress Report (3) in Jun. 2003

Outline of Pilot Works

- Design & Supervision: JICA Study Team (in full cooperation with MCTPC/DCTPC)
- Contractor: Obayashi Corporation
- Construction Period: January 2003 – May 2003 (5 months)
- Construction Cost: approx. US$ 1,259,000 (funded by JICA)
  - Ban Dongphosi (L=643m): US$ 1,088,000 (US$ 1,690/m)
  - Wat Chom Cheng (L=240m):US$ 49,000 (US$ 200/m)
  - Sibounheuang (L=156m): US$ 122,000 (US$ 810/m)

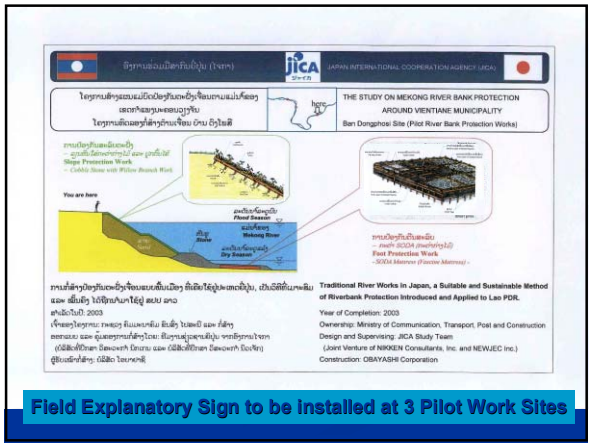
Site	Work Type of Pilot Works	Construction Length
(1) Ban Dongphosi (at Lao National Fuel Company)	1) Slope protection work (Cobble stone with willow branch work; executed by making gentle slope embankment by backfill of cliffy bank using river sand) 2) Foundation work (Riprap work) 3) Foot protection work (Soda mattress work; 66 sheets 10m*6m)	643m
(2) Wat Chom Cheng	Wooden pile groynes (6 groynes: L=20 m, interval=40 and 60m) (3 groynes were reinforced by Soda mattresses and riprap on bank for comparison)	240m
(3) Sibounheuang	1) Slope protection work (Cobble stone with willow branch work; covering lower half of the cliffy bank for cost reduction) 2) Foundation work (Riprap work) 3) Foot protection work (Soda mattress work; 23 sheets 10m*6m)	156m
	Total	1,039m


Ban Dongphosi Site
After Construction (Jan. 2004)
Before Construction (Oct. 2002)

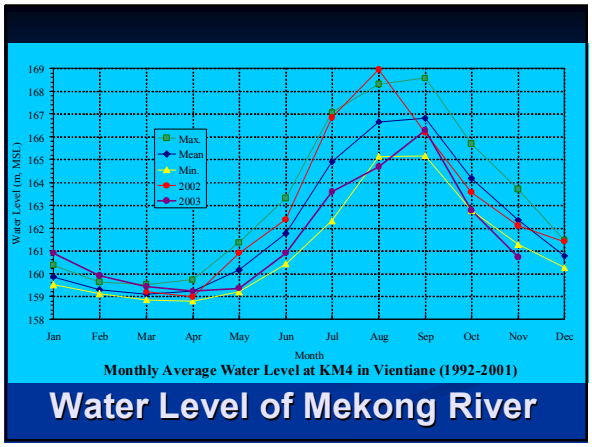

Ban Dongphosi Site
Dec. 2003


Wat Chom Cheng Site
After Construction (Jan 2004)
Before Construction (Feb. 2002)


Sibounheuang Site
After Construction (Jan 2004)
Before Construction (Dec. 2001)


JICA
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON MEKONG RIVER BANK PROTECTION AROUND VIENTIANE MUNICIPALITY
Ban Dongphosi Site (Pilot River Bank Protection Works)
Traditional River Works in Japan, a Suitable and Sustainable Method of Riverbank Protection Introduced and Applied to Lao PDR.
Year of Completion: 2003
Ownership: Ministry of Communication, Transport, Post and Construction
Design and Supervising: JICA Study Team
(Joint Venture of NIKKEN Consultants, Inc. and NEWJEC Inc.)
Construction: OBAYASHI Corporation
Field Explanatory Sign to be installed at 3 Pilot Work Sites


4. MONITORING

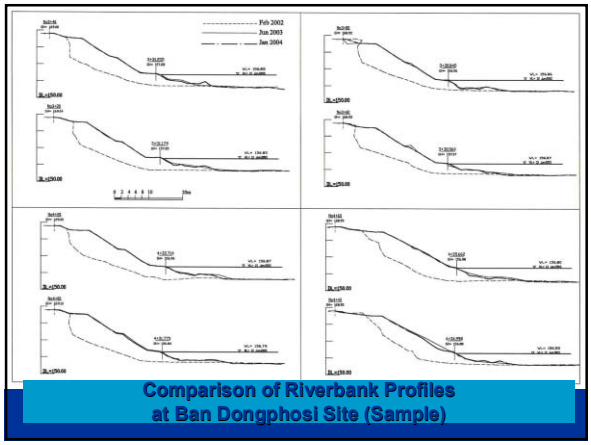


Water Level of Mekong River

(1) Pilot Works

1) Topographic Condition

- Monitoring program: 4 times (1 times/year (dry season from 2001 to 2004))
- The Pilot Works are proved effective for the bank condition at each site.
- Ban Dongphosi site:
  - Amount of sedimentation is found on the work. No remarkable changes of the work are found except:
    - local scoring spot at the toe of the slope
    - local gaps between Soda mattress and riprap foundation work



Comparison of Riverbank Profiles at Ban Dongphosi Site (Sample)

(1) Pilot Works

1) Topographic Condition

- Wat Chom Cheng site
  - Amount of sedimentation is found between groynes. No remarkable changes of the wooden piles are observed.
  - Slight inclination of wooden piles is found presumably due to soil mass movement.
  - Maximum local scouring depth: approx. 0.6 m in 2003
  - Appropriate interval of groynes will be 3 times of groyne length.

Jan. 2004

(1) Pilot Works

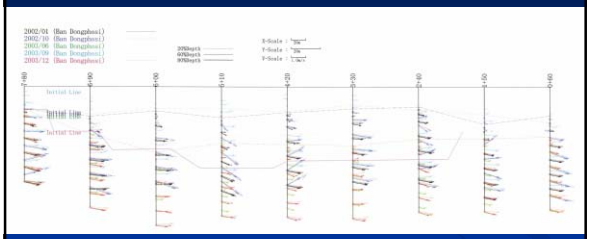
1) Topographic Condition

- Sibounheuang Site
  - Amount of sedimentation is found on the work. No remarkable changes of the work are found.
  - Upper natural bank seems to relatively stable to have some vegetation growth on it.

(1) Pilot Works

2) Hydraulic Condition

- Program: 6 times
  (2 times/year (dry and rainy season 2002 - 2004))
- Change after the Construction
  - Flow velocities became relatively small, especially at Wat Chom Cheng site due to the effect of groynes.
  - Flow directions became relatively uniform due to the effect of straightened topography.
  - Main current shifted offshore judging from velocity concentration ratio analyzed.



Distribution of Flow Velocity and Direction at Ban Dongphosi Site (Sample)

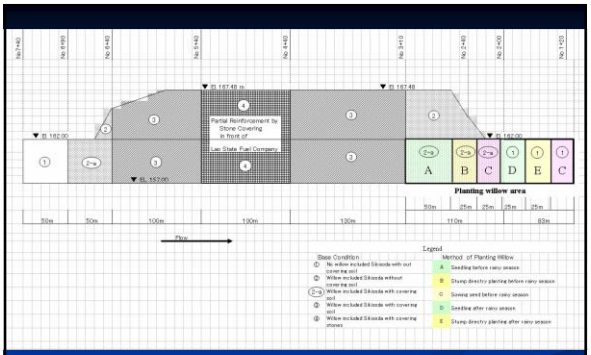
(1) Pilot Works

- 3) Vegetation Condition
- Execution of planting willow at Ban Dongphosi Site
  - Planting method:
    - 1) seedling in small plastic bucket
    - 2) stump directly planting
    - 3) seed sowing
  - Willow species:
    - 1) Khai Nun
    - 2) Kok Khai
- Period : Jul. 2003 - Dec. 2004
- Result: Survival rate:
  - seedling (32.8%)
  - stump directly (2.4%)
  - seed sowing (0%)


Seedling (grown in polybag)


Stump


Seed (Kok Khai)



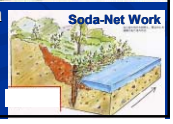
Pattern of Willow Planting on Ban Dongphosi Site

(2) Vegetation Condition at Related Sites

- Riverine Vegetation Survey
  - Location: 3 existing riverbank protection works and 1 natural riverbank
  - Period: Feb.-Mar. 2003, Dec. 2003, and May 2004
  - Result: No significant change of distribution was found before and after the rainy season in 2003 at each site.
- Soda Materials and Willow Branch Collection Site
  - The vegetation completely recovered as before collection in a year.

(3) Test of Simple Vegetation Riverbank Protection Works

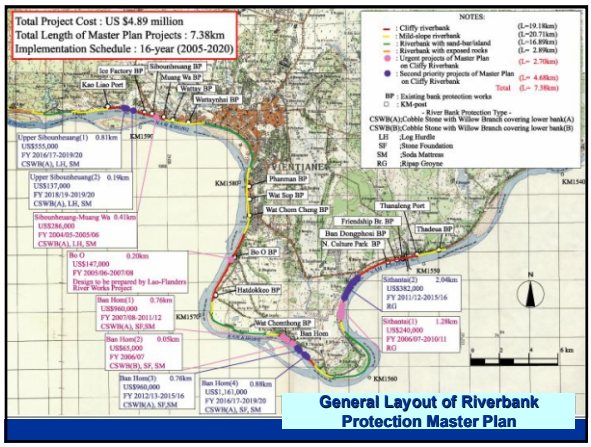
- Location:
  - 1) Nongheo (60 x 8 m)
  - 2) Chom Cheng (24 x 6 m)
- Period: Jan. 2003 - Dec. 2004
- Planting willow species:
  - 1) Khai Nun
  - 2) Kok Khai
- Planting method:
  - 1) Bundled tree with willow branch
  - 2) Soda-net of willow branch and Soda
  - 3) Seedling



(3) Test of Simple Vegetation Riverbank Protection Works

- Monitoring result: above methods seems effective, further monitoring is required, though
- Recommendation: The following could also be introduced to protect upper bank:
  - 1) Soda hurdle work
  - 2) Tie-bundle of Soda hurdle work

5. FORMULATION OF MASTER PLAN



General Layout of Riverbank Protection Master Plan

(1) Basic Framework and Principles

1) General

- The Master Plan is the principles and guideline for the bank protection activities around Vientiane City:
  - to be implemented by the Government of Lao P.D.R. (GOL) by themselves using national budget in principle after 2005, and
  - introducing traditional river works of Japan in principle.

(1) Basic Framework and Principles

2) Basic Framework and Principles

- Target year: 2020 corresponding to National Poverty Eradication Programme (NPEP) (GOL, 2003).
- Objective Area: Mekong riverbank around Vientiane City with L=approx. 65 km (Thadeua - Ban Ang)

(1) Basic Framework and Principles

2) Basic Framework and Principles

- Planning Methodology:
  - High Priority Stretches: selected from cliffy riverbanks
  - The followings are prepared for the Objective Stretches selected from the High Priority Stretches:
    - 1) Preliminary Design
    - 2) Preliminary Cost estimate
    - 3) Implementation schedule by 2020

(1) Basic Framework and Principles

2) Basic Framework and Principles

- Planning Methodology:
  - The extension of the Objective Stretches is determined by:
    - Setting up of sustainable organization and institution
    - Type of work & cost applied to each Objective Stretches
    - Sustainable & achievable budgetary allocation
    - Minimum resettlement (JICA Pilot Works completed with no resettlement.)

(1) Basic Framework and Principles

2) Basic Framework and Principles

- Sustainable Supply of Materials
  - Soda Materials -
  - Sustainable supply with proper forest preservation proved possible through the experience of Pilot Work in 2003.

(1) Basic Framework and Principles

2) Basic Framework and Principles

- Sustainable Supply of Materials -Quarry-
  - 3 quarries utilized for bank protection works in recent years:
    - Ban Sakai (the only site under operation, 50 km from Vientiane, lime stone)
    - Nong Teng (temporarily utilized for JICA Pilot Works, sand stone)
    - Tat Thong (temporarily utilized for GOL recent works, sand stone)
  - Development of new quarry exclusive for bank protection: low feasibility in view of project scale
  - Selection of quarry is the option of local contractors in principle

(1) Basic Framework and Principles

2) Basic Framework and Principles

- On-going and proposed bank protection plan/projects are principally:
  - incorporated into the Master Plan as it is
  - consist of a part of the Master Plan with high priority.

(1) Basic Framework and Principles

3) Coordination with Related Projects

- Bank Protection Plans and Projects
  - Projects by national budget:
    - Sibounheuang (L=410 m): to be constructed from 2005
    - Ban Hom (L=60 m): to be constructed in 2004

(1) Basic Framework and Principles

3) Coordination with Related Projects

- Bank Protection Plans and Projects
  - Lao-Flanders river works project:
    - On-going MCTPC project (2002-2004) at Bo O site (L=200 m) financed by GOB
    - Planning and design using gabion is underway; draft drawing is available
    - Construction will be executed by national budget; GOL is requesting GOB for the financial aid, though
  - Projects by other donors: No specific future promising project exist so far

(1) Basic Framework and Principles

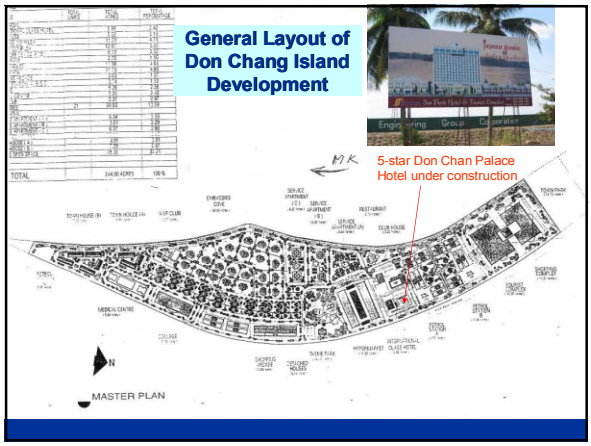
3) Coordination with Related Projects

- Related Plans and Projects
  - Urban development project by reclamation at Watchan (by Modern Home Co. Ltd.)
    - completed reclamation work (L=840 m) in 2002
    - abandoned original Don Chan Island development owing to financial difficulty.

(1) Basic Framework and Principles

3) Coordination with Related Projects

- Related Plans and Projects
  - On-going Don Chan Island development (by Rancang Timur Sdn. Bhd. (RTSB), Malaysia)
    - Don Chan Island (100ha) will be fully developed and urbanized by RTSB.
    - Bank protection of the island will be executed by RTSB.
    - Sand mining in the Mekong River for reclamation might cause some impact to riverbank.
      - On-going MRC study "Environmental Risk Assessment between Non Kai and Vientiane" including sediment transport can be utilized in near future.



(1) Basic Framework and Principles

3) Coordination with Related Projects

- Related Plans and Projects
  - Vientiane urban infrastructure and service project (VUISP) (VUDAA/ADB, 2001)
    - Riverbank protection project around Sibounheuang (L=1.06 km) was excluded from the original component.
  - Committee for prevention of impacts on river banks and ecology system
    - established by Prime Minister's Decree in April 2003 as national level activities including Vientiane
    - Setting up of organization and implementation schedule of the committee: now under consideration

(2) Mechanism of Bank Erosion

1) Changes in Plan-form and Riverbank Erosion

- Changes in Plan Form of River (during past 30 years)
  - 5 islands in the Mekong River remained at almost the same places.
  - Tam Island expanded 3 to 4 times, which caused severe bank erosion at Ban Hom.
  - As for islands in the upper reaches, their sizes are almost the same.

(2) Mechanism of Bank Erosion

1) Changes in Plan-form and Riverbank Erosion

- Recent Bank Erosion
  - The Study Area experienced 2nd biggest flood in Aug. 2002.
  - Active erosions are the cliffy banks of:
    - 1) Nahai to Sithantai
    - 2) Thakhek to Wat Chomthong (Most active: the bank was eroded by about 25 m in 2003 and about 35 m since 2001.)
    - 3) Hatdokkeo to Bo O
    - 4) Wat Muang Wa to Mekong Breeze Hotel.
  - These erosions mostly took place during the recession period of floods.

(2) Mechanism of Bank Erosion

1) Changes in Plan-form and Riverbank Erosion

- Recent Bank Erosion
  - The Pilot Work Site (erosion due to the 2002 flood before construction):
    - Ban Dongphosi site: riverbank was eroded 2.3 m on average
    - Wat Chom Cheng and Sibounheuang sites: no significant erosion except for some local portions

(2) Mechanism of Bank Erosion

1) Changes in Plan-form and Riverbank Erosion

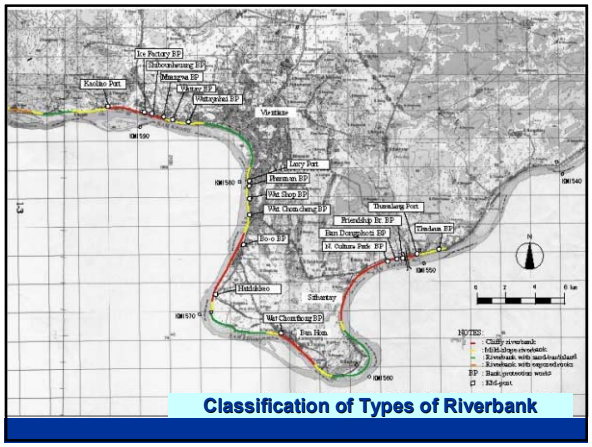
- Forecast of Progress of Erosion
  - The following could be clarified based on quite limited data available:
    - Sites of riverbank erosion would not change so much in future, judging from small change in river plan-form in the past.
    - Recent active erosions take place in the cliffy riverbanks.

(2) Mechanism of Bank Erosion

2) Riverbank Type and Coping Measures to Erosion

- Classification of Types of Riverbank
  - Objective stretch: L= 59.24 km (Thadeua to Wat Thampha), Ban Ang - Wat Thampha (5 km): not important in view of protection

Type	Length (Km)	Characteristics in view of bank protection
1) Cliffy riverbanks	19.18 (32%)	erosion prevails, most critical erosion condition with almost vertical slope with little vegetation
2) Mild-slope riverbanks	20.71 (35%)	condition between erosion and sedimentation, favorable state as a whole with vegetation
3) Riverbanks with sand bar and island	16.89 (29%)	This stretches would not require specific bank protection works
4) Riverbanks with exposed rocks	2.46 (4%)	
Total	59.24	



(2) Mechanism of Bank Erosion

2 Riverbank Types and Coping Measures to Erosion

- Coping Measures for Erosion

Items	Type-C1 Bank	Type-C2 Bank	Type-C3 Bank
Bank materials	Silty sand (gravel bed is not seen above water surface)	Silty sand on loose gravel bed	Silty sand on consolidated gravel bed
Mechanism of Bank Erosion/Failure	Scour of bank toe and erosion of slope due to attacks of river flows.	Scour of loose gravel bed at the toe of slope and erosion of slope due to attacks of river flows.	Erosion of bank slope due to attacks of river flows.
Typical Riverbanks in Study Area	- Upstream reaches of Ice Factory - Ban Hom	- Hatdokkeo to Bo O - Wat Muang Wa to Sibounheuang	- Ban Dongphosi to Sithantai, though Type-C2 banks are found in places.
Coping Measures	- To protect foot of bank-slope from scour. - To protect bank-slope from erosion. - To reduce flow velocity near riverbank.		- To protect bank-slope from erosion. - To reduce flow velocity near riverbank.
Important protection sites of higher safety	Cobble stone w/willow branch (LS&US) + Riprap or log-hurdle foundation + Soda mattress	Cobble stone w/willow branch (LS&US) + Riprap or log-hurdle foundation + Soda mattress	Cobble stone w/willow branch (LS&US) + Riprap foundation + Soda mattress
Other protection sites	1) Cobble stone w/willow branch (LS) + Riprap or log-hurdle foundation + Soda mattress 2) Riprap groyne	1) Cobble stone w/willow branch (LS) + Riprap or log-hurdle foundation + Soda mattress 2) Riprap groyne	Riprap groyne

(3) Selection of Objective Banks for Protection

1) Selection of High Priority Stretches for Protection

- High Priority Stretches (L=8.77 km) are nominated for the Master Plan through a series of screening as follows:

Unit: km

No	Site Name	Initial Screening (General Bank Condition)			Secondary Screening (Vulnerability to erosion)	Tertiary Screening (Social Importance)
		Cliffy bank	Existing work	Passed	Passed	Passed
1)	Ban Dongphosi - Sithantai	7.51	1.50	6.01	3.32	3.32
2)	Ban Hom	2.61	0.16	2.45	2.45	2.45
3)	B. Hatdokkeo - u/s Bo O	5.12	0.63	4.49	1.51	0.97
4)	Muang Wa -Kaoliao Port	3.94	0.86	3.08	2.03	2.03
	Total length	19.18	3.15	16.03	9.31	8.77

(3) Selection of Objective Banks for Protection

1) Arrangements for Implementation

- Nominated High Priority Stretches are divided into two project groups, i.e.,
  - Urgent Projects (L=2.70 km):
    - to be implemented immediately considering:
      - seriousness of erosion
      - possible damage under the present conditions
  - Second Priority Projects (L=6.07 km):
    - to be implemented after the completion of the Urgent Projects.

(3) Selection of Objective Banks for Protection

1) Arrangements for Implementation

Site Name	High Priority Stretches nominated for M/P	Length (meter)	Priority	
			Urgent	2nd
Sithantai	Sithantai (1)	1,280	○	
	Sithantai (2)	2,040		○
Ban Hom	Ban Hom (1)	760	○	
	Ban Hom (2)	50	○	
	Ban Hom (3)	760		○
	Ban Hom (4)	880		○
Hatdokkeo	Hatdokkeo	770		○
Bo O	Bo O	200	○	
Sibounheuang - Muang Wa	Sibounheuang - Muang Wa	410	○	
Upper Sibounheuang	Upper Sibounheuang (1)	810		○
	Upper Sibounheuang (2)	190		○
	Upper Sibounheuang (3)	350		○
	Upper Sibounheuang (4)	40		○
	Upper Sibounheuang (5)	230		○
Total		8,770	2,700	6,070

(4) Preliminary Design of Facilities

- Preliminary design of 4 sites including the Urgent Projects is conducted as follows:
  - Sithantai (L=3,320 m)
  - Ban Hom (L=2,450 m)
  - Bo O (L=200m)
  - Sibounheuang – Muang Wa (L=410m)
- Design of Bo O site
  - is to be prepared by on-going "Lao-Flanders River Works Project" of MCTPC financed of GOB
  - is incorporated into the Master Plan as it is.

(4) Preliminary Design of Facilities

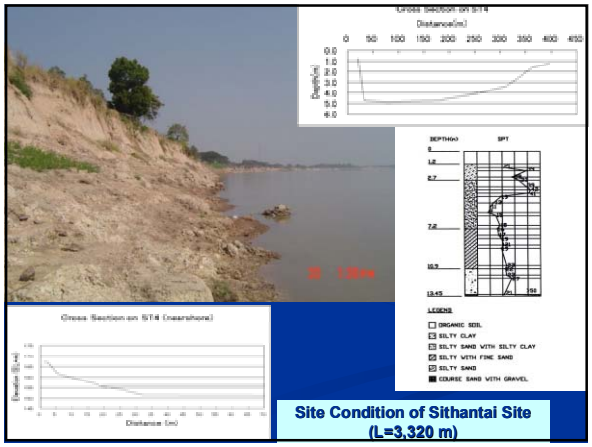
1) Condition of Site

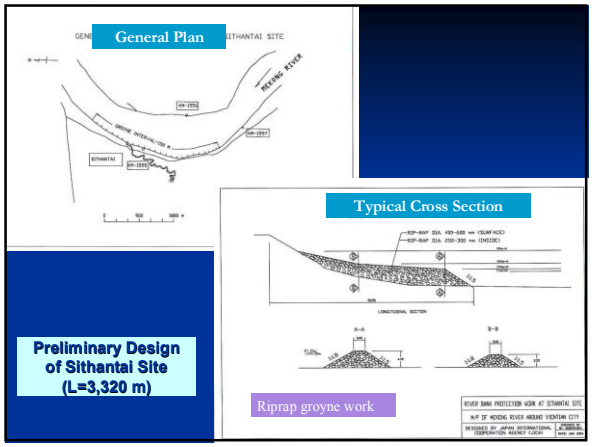
Item	Site Name: Sithantai	Site Name: Ban Hom	Site Name: Sibounheuang, Muang Wa
Total length (m)	3,320	2,450	410
Conditions of river bank slope	-Upper vertical cliff and lower slopes of new aged silt layer on the layer of gravel and silt mixture. -Both are vulnerable to erosion	-Vertical high cliff of new aged silt layer on the layer of gravel and silt mixture. -Both are vulnerable to erosion	-Vertical cliff of old aged silt layer on the layer of gravel and silt mixture. -Lower layer is vulnerable to erosion
Type of erosion	Falling of cliff material with setback of lower layer of gravel and silt vulnerable to scoring during flood period.		Falling of cliff material as block undermined through lower layer of gravel and silt forming notches at the foot of slope during flood period.
Protection principle	To reduce erosion at lower gravel and silt mixture layer.	To protect not only lower gravel and silt mixture layer, but upper silt layer.	To protect the lower gravel and silt mixture layer

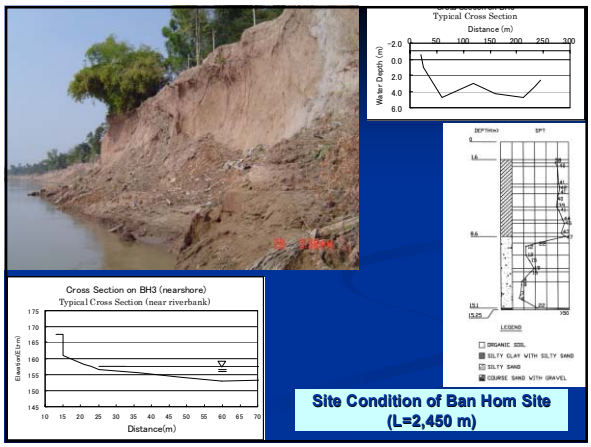
(4) Preliminary Design of Facilities

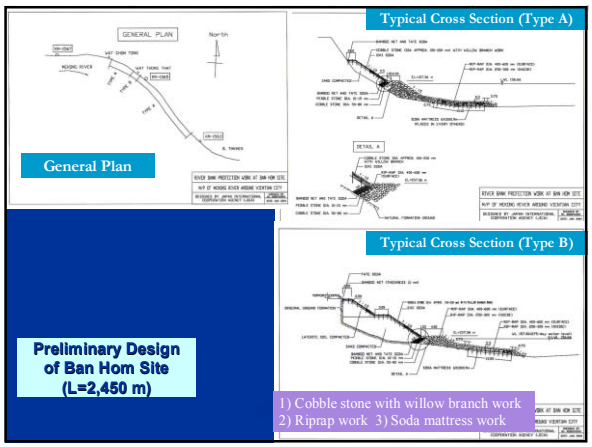
1) Preliminary Design

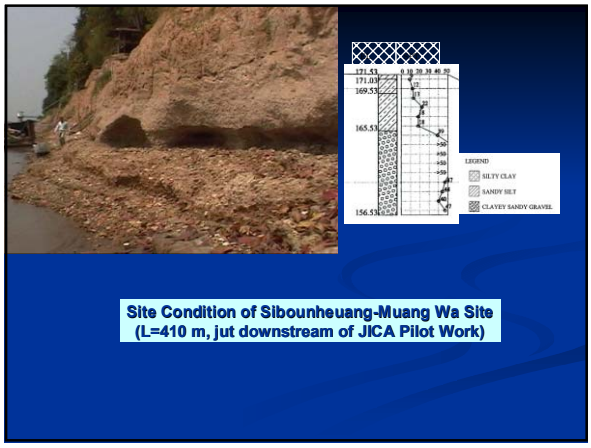
Site Name	Type of Construction Work
Sithantai	Riprap groyne work (L=50 m, Interval=150 m, Height=4.5m - 2.0 m)
Ban Hom	<Type A> (low dense riverine land use) 1) Slope protection work (Cobble stone with willow branch work covering lower bank for cost reduction) 2) Foundation work (Riprap work) 3) Foot protection work (Soda mattress work "in every others" for cost reduction)
	<Type B> (in front of Wat Thong that) 1) Slope protection work (Cobble stone with willow branch work) 2) Foundation work (Riprap work) 3) Foot protection work (Soda mattress work)
Sibounheuang -Muang Wa	1) Slope protection work (Cobble stone with willow branch work) 2) Foot protection work (Log-hurdle work) 3) Foot protection work (Soda mattress work)

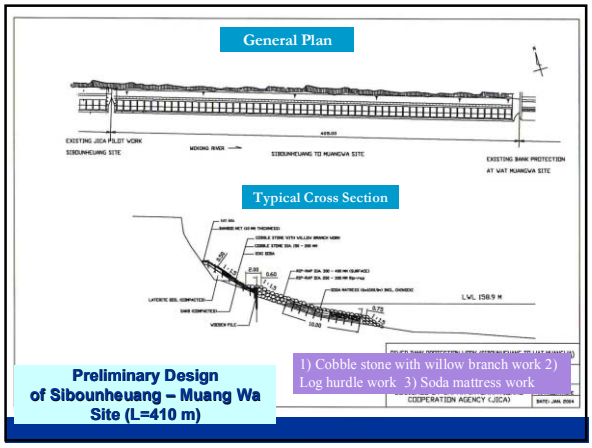

Site Condition of Sithantai Site
(L=3,320 m)

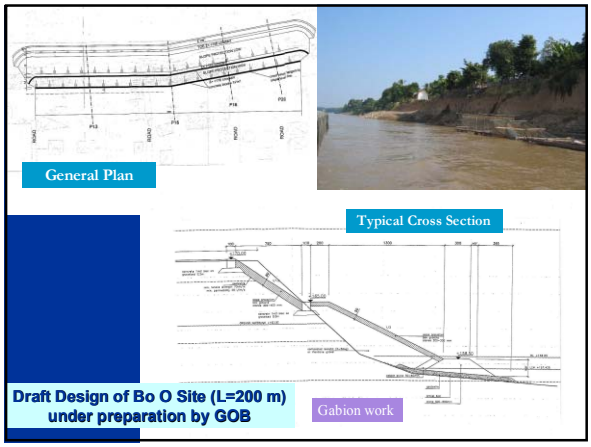

General Plan
Typical Cross Section
Preliminary Design
of Sithantai Site
(L=3,320 m)
Riprap groyne work


Site Condition of Ban Hom Site
(L=2,450 m)


Typical Cross Section (Type A)
General Plan
Typical Cross Section (Type B)
Preliminary Design
of Ban Hom Site
(L=2,450 m)
1) Cobble stone with willow branch work
2) Riprap work 3) Soda mattress work


Site Condition of Sibounheuang-Muang Wa Site
(L=410 m, jut downstream of JICA Pilot Work)

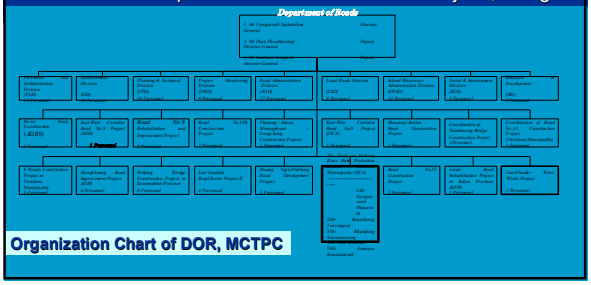

General Plan
Typical Cross Section
Preliminary Design
of Sibounheuang – Muang Wa
Site (L=410 m)
1) Cobble stone with willow branch work 2)
Log hurdle work 3) Soda mattress work



(5) Institution and Organization

1) Set up of New Permanent Organization

- No permanent organization name relating to bank protection in the organization chat of DOR, MCTPC
  - DCTPC has permanent "Bank Protection Project", though.



(5) Institution and Organization

1) Set up of New Permanent Organization

- The Study office in MCTPC is temporarily one on a project basis and will be closed after 2005?
- Setting up of ***"New Permanent Organization for Riverbank Protection"*** should be established in MCTPC:
  - to realize sustainable implementation of the Master Plan projects, and
  - as the preparation to receive possible future donor's technical assistance after year 2005.

(5) Institution and Organization

2) Human Resources Arrangement

- Proper human resources arrangement to the New Organization is crucial preconditions for the success of sustainable implementation of the Master Plan projects.
- Present MCTPC counterpart personnel for the Study shall be the core of the New Organization especially in the early stage of the implementation.

(5) Institution and Organization

3) Human Resources Development

- Continuous human resources development is also the essentials to transfer knowledge on river bank protection from one generation to the next in GOL.
- The following activities is necessary:
  - Proper arrangement of new employees to the New Organization
  - Practical training of the new employees
  - Development of the teaching material for the training
  - Public education on the importance of the river bank protection and for future recruitment as follows:
    - Receiving trainee from various educational institutions
    - Making lectures and having seminar at various relating agencies

(6) Socioeconomic and Financial Conditions

1) Socioeconomic Development Plans

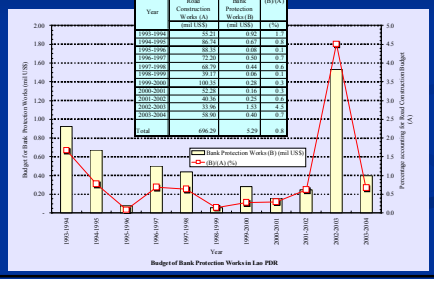
- GOL emphasizes to eliminate the country's poverty by 2020.
- Economic growth target of National Socioeconomic Development Plans: around 7% p.a.

(6) Socioeconomic and Financial Conditions

2) Financial Conditions

- GOL finance has highly depended on ODA (3/4 of capital expenditure).
- GOL clearly states to reduce gradually high dependency on ODA.
- Expenditure of MCTPC for riverbank protection has remained less than 1% of the budget for road construction except FY2002/03 with JICA Pilot Works.

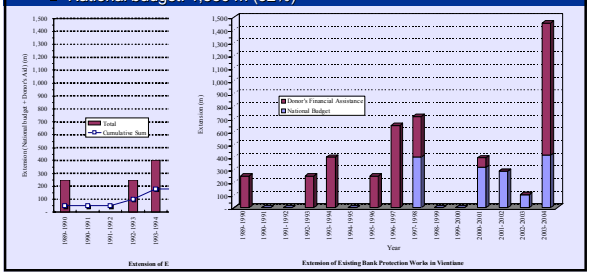
Year	Road Construction Works (A) (mil US$)	Bank Protection Works (B) (mil US$)	(B)/(A) (%)
1993-1994	55.21	0.92	1.7
1994-1995	86.74	0.87	1.0
1995-1996	88.35	0.08	0.1
1996-1997	72.20	0.50	0.7
1997-1998	68.79	0.44	0.6
1998-1999	39.17	0.06	0.1
1999-2000	100.35	0.28	0.3
2000-2001	52.28	0.18	0.3
2001-2002	40.36	0.25	0.6
2002-2003	33.96	1.53	4.5
2003-2004	58.90	0.40	0.7
Total	696.29	5.29	0.8



(6) Socioeconomic and Financial Conditions

2) Financial Conditions

- Cumulative length of existing riverbank protection works in Vientiane City from 1989 up to date: approx. 4,770 m
  - Donor's financial assistance: 3,240 m (68%) (Pilot Works: 1,039 m)
  - National budget: 1,530 m (32%)



(7) Non-structural Measures

1) Public Awareness Campaign

- Launching a campaign by GOL to educate the population of Vientiane City on the importance:
  - to protect riverbank from erosion
  - to create environmental friendly riparian zone by nature-oriented works
- Public relations using media (newspaper/TV) should be continued and expanded.
- Prior to the construction, GOL should ask representatives of local residents at each project site to understand the contents of the projects.

(7) Non-structural Measures

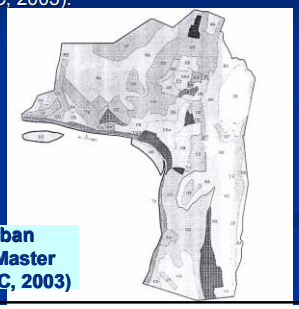
2) People's Involvement

- It is virtually impossible for GOL to protect all the Cliffy riverbanks (16.03 km) owing mainly to budgetary limitation.
  - Length of Master Plan projects = 7.38 km
- An approach "planting willow" is also essential by simple vegetation work only by manpower of local residents introducing Soda technique.
- GOL support and train local community leaders, provide guidance and information.

(7) Non-structural Measures

3) Riparian Land Use Regulation

- Riverbank area (L=20 km) along city center is categorized as riverside area in revised "Vientiane Urban Development Master Plan" (URI-MCTPC, 2003).



Vientiane Urban Development Master Plan (URI-MCTPC, 2003)

(7) Non-structural Measures

3) Riparian Land Use Regulation

- in accordance with the principles proposed by the plan as follows:
  - Construction of new building & heavy weight facilities is not allowed except for light weight public facilities.
  - Present resident can live as usual except for GOL require resettlement for bank protection works.
    - Target of JICA Master Plan = 0 resettlement
  - Temple and cultural assets should be preserved as it is.

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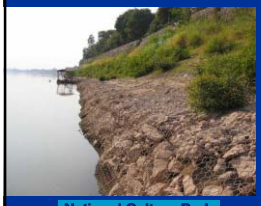
- JICA Laos Office will implement more tree planting and placing some benches at Ban Dongphosi Site soon.
- Future ideal image: attractive ***greenbelt*** for local residents & foreign tourist.

(7) Non-structural Measures

5) Monitoring and Maintenance System

- Regular visual inspection of
  - natural riverbanks
  - existing bank protection works especially in a dangerous condition as follows:



National Culture Park (Jan 2004)

Hatdokkeo (Dec 2003)

(7) Non-structural Measures

5) Monitoring and Maintenance System

- Regular visual inspection and maintenance work of the Pilot Works by GOL after 2005
  - 5 years after the completion (2003 – 2008): until the vegetation and sedimentation on the works is stabilized
  - The monitoring is essential:
    - to detect damaged portion and repair it in earliest stage
    - to localize traditional river works of Japan to Lao P.D.R.
  - Wat Chom Cheng (real test work): inspection is continued without any rehabilitation work unless unforeseen erosion
- Monitoring cross-sectional survey on riverbed fluctuation for detail design by GOL

(8) Preliminary Estimation of Project Cost

1) Material and Equipment

- The cost estimation is principally based on the followings items utilized for the Pilot Works in 2003.
  - 1) Specification of materials
  - 2) procurement
  - 3) equipment
  - 4) Unit cost (material, equipment rental, major work)

(8) Preliminary Estimation of Project Cost

2) Preliminary Project Cost

Priority by Priority	Urgent Projects					Second Priority Projects								
Stretch No.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Project Name	Sithantai	Ban Hom		Bo O	Sibounheuang-Muang Wa	Sithantai	Ban Hom		Hatdokkeo	Upper Sibounheuang				
Project No.	(1)	(1)	(2)	Bo O	Sibounheuang-Muang Wa	(2)	(3)	(4)	Hatdokkeo	(1)	(2)	(3)	(4)	(5)
Stretch Length (meters)	1280	760	50	200	410	2040	760	880	770	810	190	350	40	230
Bank Protection Type														
CSWB-Work (A)		○		○	○		○	○		○	○	○	○	○
CSWB-Work (B)			○											
LH-Work				○	○					○	○	○	○	○
SF-Work		○	○				○	○						
SM-Work		○	○	○	○		○	○		○	○	○	○	○
RG-Work	○					○			○					
Unit: US$														
Construction Cost (A)	228,416	914,000	61,360	139,070	272,110	363,076	914,000	1,105,690	141,730	528,310	129,570	233,940	34,690	163,410
Administration Cost (B)	11,420	45,700	3,068	6,950	13,606	18,150	45,700	55,280	7,086	26,416	6,478	11,695	1,730	8,170
Project Cost (US$)	240,000	960,000	65,000	147,000	286,000	382,000	960,000	1,161,000	149,000	555,000	137,000	246,000	37,000	172,000

NOTE: CSWB-Work (A): Cobble Stone with Willow Branch Work, Type (A)
CSWB-Work (B): Cobble Stone with Willow Branch Work, Type (B)
LH Work: Log Hurdle Work
SF-Work: Stone Foundation Work
SM-Work: Soda Mattress Work
RG-Work: Riprap Groyne Work

- Bo O project:
  - Design to be prepared by on-going "Lao-Flanders River Works Project" of MCTPC.
  - Work Type Concept of the Master Plan is temporarily applied for the cost estimate instead.

(9) Alternative Study

1) Work Type Alternatives

- Work type is selected considering the following criteria; some of Japanese traditional river works satisfied the criteria:
  - using local construction material/ manpower as much as possible
  - construction can be done by the manpower of Laotian as much as possible
  - pay attention to keep and/or create better riparian environment
  - without using imported materials; gabion mattress and concrete block are excluded from the selection

(9) Alternative Study

1) Work Type Alternatives

- "Priority 1" below is selected as the most suitable type by comparing with respect to various factors such as strength, easiness of material collection, construction cost, etc.
- The preliminarily design is conducted according to this result.

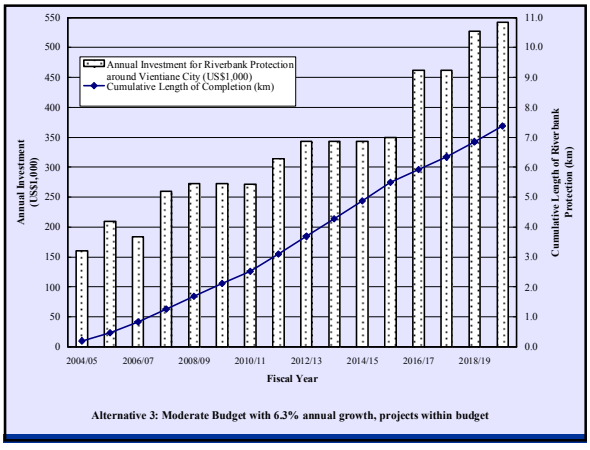
Site Name	Candidate Type of Construction Work	Priority
Sithantai	Cobble stone with willow branch work + Riprap foundation + Soda mattress work	2
	Wooden pile groyne work	3
	Riprap groyne work (Mekong river flow is shifted away from the riverbank with low cost at low-density housing land use)	1
Ban Hom	Cobble stone with willow branch work + Log-hurdle work + Soda mattress work	3
	Cobble stone with willow branch work + Riprap foundation + Soda mattress work (less impact in the opposite bank, Don Tom island, comparing with groyne type)	1
	Riprap groyne work	2
Sibounheuang -Muang Wa	Cobble stone with willow branch work + Log-hurdle work + Soda mattress work (similar work type with that the subsequent JICA's Pilot Work)	1
	Cobble stone with willow branch work + Riprap foundation + Soda mattress work	2
	Riprap groyne work	3

(9) Alternative Study

2) Financial Alternatives

- "Alternative 3" (total project cost=US$4.89 million, L=7.38 km) is selected as the most appropriate plan from financial viewpoints.

	Unit	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
1.Base Year Budget (FY2003/04)	M Kip	2,800		2,300		1,000
		Calculated budget to complete all the priority stretches by 2020	MCTPC's investment plan for riverbank protection around Vientiane City in FY2003/04.			Actual average investment by national budget for bank protection around Vientiane City for last 4 years.
2. Budget in the 1st Year of the M/P (FY2004/05)	M Kip	3,000	2,450	2,445	2,392	1,063
		7% increase from FY2003/04	6.5% increase from FY2003/04 based on NPEP	6.3% increase from FY2003/04	4% increase from FY2003/04	6.3% increase from FY2003/04
3. Growth rate of budget from FY2004/05 to FY201920	%	7	7	6.3	4	6.3
		Economic development target of the country for 2020 stated in National Poverty Eradication Programme (NPEP)		Average annual economic growth rate for the last 10 years	The lowest annual economic growth rate for the last 10 years	Average annual economic growth rate for the last 10 years
4. Project Cost	US$1,000	5,497	5,176	4,893	3,634	1,698
5. Length of BP	km	8.77	7.77	7.38	5.95	2.70
1) Urgent project	km	2.70	2.70	**2.70**	2.70	2.70
2) 2nd priority proj.	km	6.07	5.07	**4.68**	3.25	0.00



Alternative 3: Moderate Budget with 6.3% annual growth, projects within budget

Table 5.9.5 Investment and Budgeting Plan fo
(Alternative 3: Moderate Budget with

Project	Total Cost (US$1,000)	Length (m)	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
I. Investment Plan								
1. Urgent Projects								
(1) Sithantai (1)	240	1,280	-	-	47	47	49	49
(2) Ban Hom (1)	960	760	-	-	-	139	202	202
(3) Ban Hom (2)	65	50	-	-	65	-	-	-
(4) Bo O	147	200	-	44	51	52	-	-
(5) Sibounheuang-Muang Wa	286	410	140	146	-	-	-	-
Sub-total of 1	1,698	2,700	140	190	163	238	251	251
2. Second Priority Projects								
(6) Sithantai (2)	382	2,040	-	-	-	-	-	-
(7) Ban Hom (3)	960	760	-	-	-	-	-	-
(8) Ban Hom (4)	1,161	880	-	-	-	-	-	-
(9) Hatdokkeo			To be implemented after FY2020/21				-	-
(10) Upper Sibounheuang (1)	555	810	-	-	-	-	-	-
(11) Upper Sibounheuang (2)	137	190	-	-	-	-	-	-
(12) Upper Sibounheuang (3)			To be implemented after FY2020/21				-	-
(13) Upper Sibounheuang (4)							-	-
(14) Upper Sibounheuang (5)			-	-	-	-	-	-
Sub-total of 2	3,195	4,680	-	-	-	-	-	-
Sub-total (1+2)	4,893	7,380	140	190	163	238	251	251
3. Maintenance & repair			20	20	21	22	22	22
Total (1+2+3)			160	210	184	260	273	273
II. Budgeting Plan (Million Kip)			2,445	2,599	2,763	2,937	3,122	3,319
(Equiv. US$1,000)			235	249	265	282	300	319
Balance by Fiscal Year (US$1,000)			75	39	81	22	27	46

Basic Condition of Estimation:

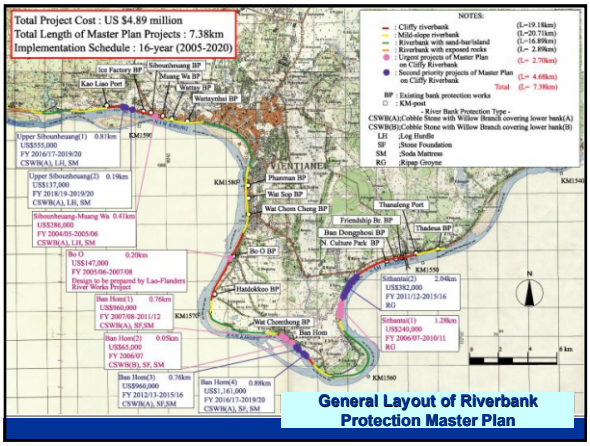
(10) Proposed Master Plan

- The outline of proposed Master Plan:
  - Total project cost (national budget in principle): US$4.89 million (Alternative 3)
  - Implementation schedule: 16-years (2005-2020)
  - Total length of 10 Master Plan projects: 7.38 km
    - Five (5) Urgent Projects: 2.70 km
    - Five (5) Second Priority Projects: 4.68 km
    - The remaining 4 Second Priority Projects, Hatdokkeo and Upper Sibounheuang (3), (4) & (5) are to be implemented after 2020.

(10) Proposed Master Plan

- The outline of proposed Master Plan:
  - Investment and budgeting plan (early stage)

FY	Budgeting Plan (Investment Plan) <US$1,000>	M/P Projects implemented by GOL	Length of Construction (m)
2004/2005	235 (160)	Sibounheuang - Muang Wa	200
2005/2006	249 (210)	Sibounheuang - Muang Wa Bo O Total	210 60 270
2006/2007	265 (184)	Sithantai (1) Ban Hom (2) Bo O Total	250 50 70 370
2007/2008	282 (260)	Sithantai (1) Ban Hom (1) Bo O Total	250 110 70 430



General Layout of Riverbank Protection Master Plan

Basic Principles of Protection Measures of Master Plan

Type of Riverbank	Classification of City riverbanks	Length (km)	Principles of Bank Protection Measures
1)Cliffy Riverbanks	Existing riverbank protection works	3.15 (5.3%)	to be monitored and rehabilitated if necessary by GOL (O&M).
	Objective stretches for Urgent Projects	2.70 (4.6%)	to be implemented by GOL from 2004/2005 to 2011/2012.
	Objective stretches for Second Priority Projects	4.68 (7.9%)	*to be implemented by GOL from 2011/2012 to 2019/2020. * would be protected by people's involvement as the need arises until the start of the Projects by GOL at each sites.
	Remaining Stretches To be implemented aster 2020/2021	8.65 (14.6%)	* to be protected by GOL after 2020/2021 * would be protected by people's involvement as the need arises.
Sub-total	19.18 (32.4%)		
2)Mild-slope riverbanks	20.71 (35.0%)		This stretches with no active erosion in general would be protected by people's involvement as the need arises.
3) Riverbanks with sand bar and island	16.89 (28.5%)		These stretches would not require specific bank protection activities.
4) Riverbanks with exposed rocks	2.46 (4.2%)		
Total	59.24(100%)		

(11) Project Evaluation

1) Economic Evaluation

- The riverbank protection is given the status of an indispensable public investment:
  - to conserve national land
  - to maintain the border
  - to protect temples which is an integral part of people's life.
- The Master Plan projects have direct economic benefit to save US$9.9 million or 66% comparing with that by the conventional gabion works for GOL.

Work Type	Conventional Gabion woks (A)	Work Types proposed in the Master Plan (B)	Balance (A) – (B)
Project Cost for 7.38 km (US$ million)	14.8	4.9	9.9

(11) Project Evaluation

1) Economic Evaluation

- Average construction cost by work type

Construction Method		Average Cost (US$/meter)
1.	Conventional Gabion Works implemented around Vientiane City	2,000
2.	Work Types proposed in the Master Plan	
(1)	Riprap groyne work (L=50m, interval=150m)	100
(2)	1) Cobble stone with willow branch work covering upper bank 2) stone foundation and 3) soda mattress	300
(3)	1) Cobble stone with willow branch work covering lower bank 2) stone foundation and 3) soda mattress (in every other)	1,200
(4)	1) Cobble stone with willow branch work covering lower bank 2) log hurdle work and 3) soda mattress	700
3.	JICA Pilot Works (Reference)	
(1)	Ban Dongphosi Site	1,690
(2)	Wat Chom Cheng Site	200
(3)	Sibounheuang Site	810

(11) Project Evaluation

1) Economic Evaluation

- The Master Plan projects will create the following new job opportunities equivalent to cash income of US$77,000 during construction works:

	New Job Opportunity (man-day)		
	Urgent Projects	2nd Priority Proj.	Total
1. Skilled labor	2,200	4,000	6,200
2. Unskilled labor	8,800	16,000	24,800
Total	11,000	20,000	31,000

(11) Project Evaluation

1) Initial Environmental Examination (IEE)

- IEE of 4 sites including the Master Plan project sites proves that the projects have no serious environmental impact potentially as follows, since the projects create better riparian environment:
  - During construction stage:
    Most of check items are D (no impact).
  - Operation/maintenance stage:
    Most of check items are D (no impact)

(11) Project Evaluation

3) Overall Evaluation

- The proposed Master Plan is evaluated feasible, sustainable and appropriate from the following viewpoint:
  - technical,
  - financial,
  - economical, and
  - environmental.

(12) Implementation Schedule <16-year (2005-2020) >

Project	Length (m)	Implementation (meters)														
		2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
1. Implementation																	
1. Urgent Projects																	
(1) Silhuntai (1)	1,280			640	640	640	640	640									
(2) Ban Hom (1)	760				110	160	160	160	170								
(3) Ban Hom (2)	50			50													
(4) Bo O	200		60	70	70												
(5) Sibounheuang-Muang Wa	410	200	210														
Sub-total of 1	2,700	200	270	370	430	420	420	420	170	-	-	-	-	-	-	-	-
2. Second Priority Projects																	
(6) Silhuntai (2)	2,040								600	600	600	600	640				
(7) Ban Hom (3)	760									190	190	190	190				
(8) Ban Hom (4)	880													220	220	220	220
(9) Hatxhikeo		To be implemented after FY2020/21															
(10) Upper Sibounheuang (1)	810													200	200	200	210
(11) Upper Sibounheuang (2)	190															90	100
(12) Upper Sibounheuang (3)																	
(13) Upper Sibounheuang (4)		To be implemented after FY2020/21															
(14) Upper Sibounheuang (5)																	
Sub-total of 2	4,680	-	-	-	-	-	-	-	600	790	790	790	830	420	420	510	530
Total (1+2)	7,380	200	270	370	430	420	420	420	770	790	790	790	830	420	420	510	530
II. Maintenance works																	

Figure 5.12.1 Implementation Schedule of Master Plan

6. PREPARATION OF MANUAL FOR RIVERBANK PROTECTION

- Objective: a complement of the Master Plan
- User: working-level Laotian engineer
- Contents: basic principles for bank protection works, technical standards and criteria:
- Part A: Planning & Design
  - 1 Planning
  - 2 Design
- Part B: Construction
  (mainly contents of Progress Report (2) & (3))
  - 1 Introduction
  - 2 Execution of Pilot Work at Ban Dongphosi Site
  - 3 Execution of Pilot Work at Wat Chom Cheng Site
  - 4 Execution of Pilot Work at Sibounheuang Site
  - 5 Construction Data

7. MONITORING SURVEY FOR PILOT WORKS

- The following monitoring surveys were conducted at 3 completed Pilot Work sites:
  - Cross-sectional survey
    (1time: Dec. 2003-Feb. 2004)
  - Velocity measurements
    (2 times: Sep. 2003 and Dec. 2003-Jan. 2004)

8. RECOMMENDATION

- Set up of organization and institution in MCTPC
- Review and revision of the Master Plan by GOL in 2010 and 2015
- Avoidance of resettlement on construction work
- Detailed facility design and cost estimate to be conducted by GOL
- Status of on-going Bo O project in the Master Plan
- Collection of available quarry information
- Maintenance of the Pilot Works by GOL

END

THE STUDY ON
MEKONG RIVERBANK PROTECTION
AROUND
VIENTIANE MUNICIPALITY

DRAFT FINAL REPORT

MATERIAL FOR STEERING COMMITTEE

October 6, 2004
JICA Study Team
(NIKKEN Consultants, Inc. and NEWJEC Inc.)

Today's Discussion Items

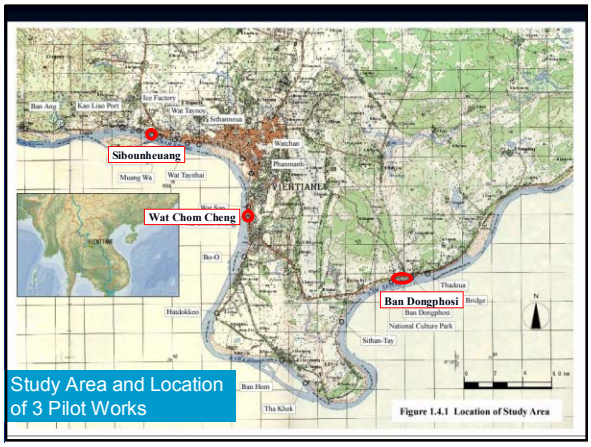
- 1) Introduction
- 2) Present Condition in the Study Area
- 3) Pilot Riverbank Protection Works
- 4) Test of Simple Vegetation Works
- 5) Riverbank Protection Master Plan
- 6) GOL Activity from 2005
- 7) JICA Follow-up Plan from 2005

- *2nd Technology Transfer Seminar* will be held on October 12 at Novotel, Vientiane.

1. INTRODUCTION

Objectives of the Study

- To study bank protection works adaptable to the Mekong River and sustainable in Lao P.D.R., introducing river works in Japan.
- To transfer technology to the counterpart personnel through Pilot Works.
- To formulate a bank protection Master Plan for the Mekong River around Vientiane City (=60 Km).



Study Area and Location of 3 Pilot Works

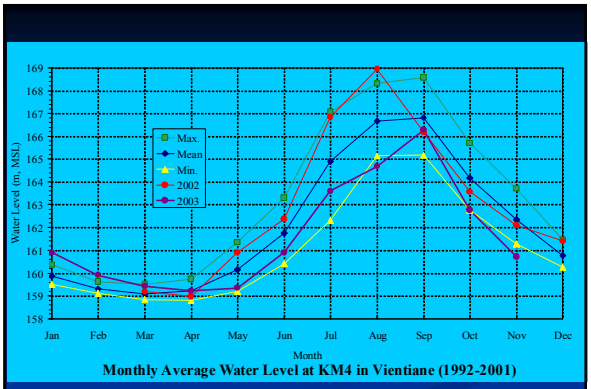
Overall Work Schedule

- 1st year (Dec. 2001-Mar. 2002): Basic study
- 2nd year (Oct. 2002- Mar. 2003): Execution of pilot works
- 3rd year (Apr. 2003- Feb.2004) :
  - Execution of pilot works
  - Monitoring of pilot works
  - Formulation of Master Plan
- 4th year (Nov. 2004- Dec. 2004)
  :Monitoring of Pilot Works & Final Reporting
  - Draft Final Report & 2nd Technology Transfer Seminar : Oct. 2004
  - Final Report: Dec. 2004

2. PRESENT CONDITION IN THE STUDY AREA

Characteristics of the Mekong River in the Study Area

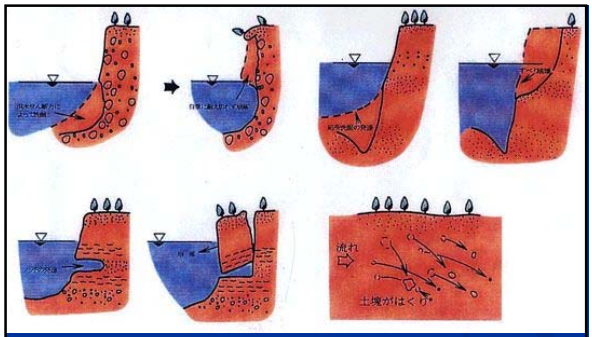
- Average riverbed slope: 1/8,100
- Average river width: 773 m (excluding islands)
- Riverbed materials: 0.44 mm
- Water Level (refer to next page)



Water Level of Mekong River

Riverbank condition

- Severely eroded bank form vertical cliffs mostly.
- Geology: sandy gravel layer covered with 6-8 m clayey soil. These are not consolidated and easily be eroded.
- Bank protection works commonly used are gabion works. The existing works are effective, though some works are damaged due to poor foot protection.



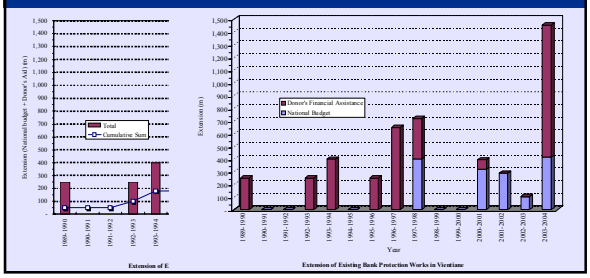
Mechanism of Bank Erosion at Mekong River

Existing Bank Protection Works

- Bank protection works have been implemented since early 1990s.
- Most of protection works done by gabion.
  - at many locations, silt deposits with partly covered by vegetation are found.
  - some of wire nets have been corroded to become thin and partly damaged in a long period after construction.

Existing Bank Protection Works

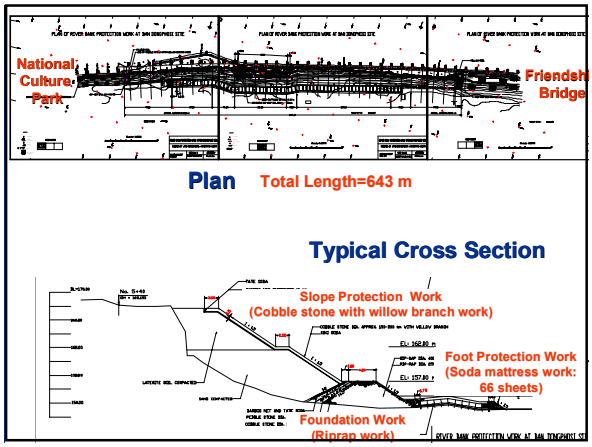
- Existing works in Vientiane City (1989-): 4,800 m
  - Donor's financial assistance: 3,240 m (68%)
    (JICA Pilot Works: 1,039 m)
  - National budget: 1,530 m (32%)



3. PILOT RIVERBANK PROTECTION WORKS

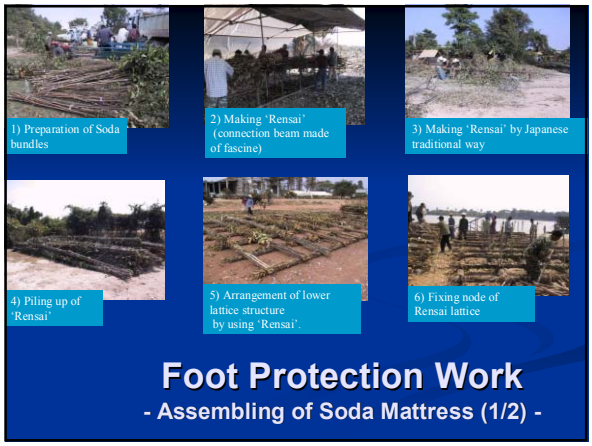
Outline of the Pilot Works

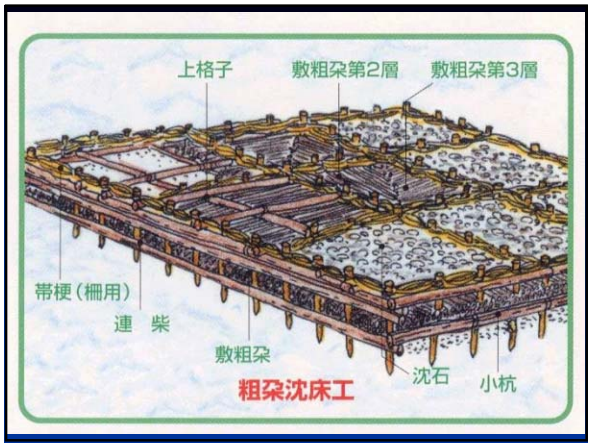
- Design & Supervision: JICA Study Team (in full cooperation with MCTPC/DCTPC)
- Contractor: Obayashi Corporation, Japan
- Construction Period:
  January 2003 – May 2003 (5 months)
- Construction Cost: approx. US$ 1,259,000
  (funded by JICA)
  - Ban Dongphosi: US$ 1,088,000 (US$ 1,690/m)
  - Wat Chom Cheng: US$ 49,000 (US$ 200/m)
  - Sibounheuang: US$ 122,000 (US$ 810/m)
- Resettlement = 0


National Culture Park
Friendship Bridge
Plan
Total Length=643 m
Typical Cross Section
Slope Protection Work
(Cobble stone with willow branch work)
Foot Protection Work
(Soda mattress work: 66 sheets)
Foundation Work
(Riprap work)


Cobble Stone with Willow Branch Work in Japan
WODDEN PILE
After completion, willows will grow and will cover and grasp the surface of the slope
Image of Completio


Location of Material Collection Sites
Danxi
Laksamsip
Ban Sakai (50 km from city center)
Nong Teng
Donloun
Kao Liao
Sibounheuang
Nongpen
Xiangkhouan
Wat Chom Cheng
Ban Dongphosi
2 km
: Quarry site
: Fascine material site
: Stockyard
: Borrow site of sand, gravel and laterite

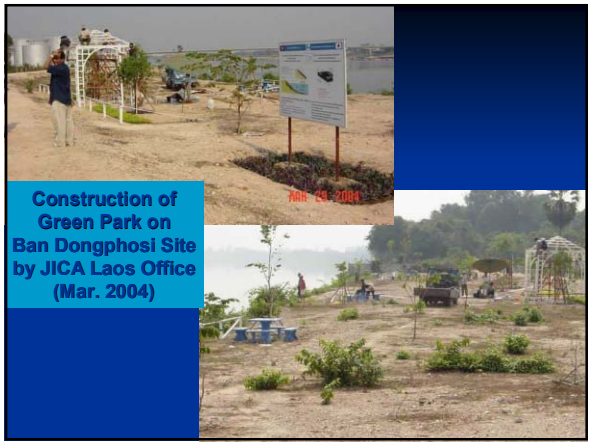

1) Preparation of Soda bundles
2) Making 'Rensai' (connection beam made of fascine)
3) Making 'Rensai' by Japanese traditional way
4) Piling up of 'Rensai'
5) Arrangement of lower lattice structure by using 'Rensai'.
6) Fixing node of Rensai lattice
Foot Protection Work
- Assembling of Soda Mattress (1/2) -


上格子
敷粗朶第2層
敷粗朶第3層
帯梗(柵用)
連 柴
敷粗朶
沈石
小杭
粗朶沈床工

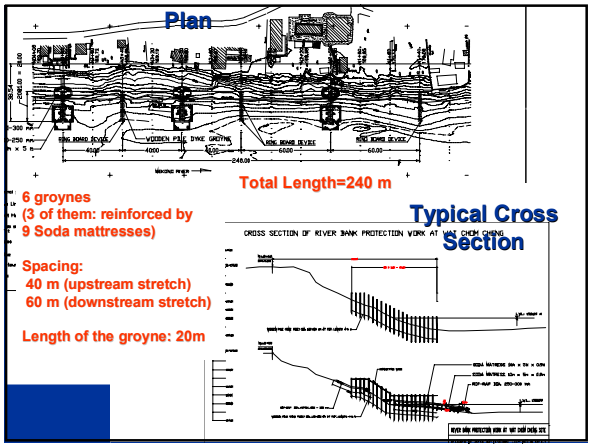

7) Flooring 'Siki-Soda' work
8) Arranging higher lattice beam
9) Piling short wooden piles to combine upper and lower lattice structures and for hurdling work
10) Preparation of 'Taisha', flexible tie-twigs
11) Hurdling work by using 'Taisha'
12) Piling-up of completed Soda mattresses
Foot Protection Work
- Assembling of Soda Mattress (2/2) -


1) Lowering Soda mattress to the bank slope
2) Placing Soda mattress at the planed position by Crawler crane
3) Piling of wooden short pile to the final depth
4) Connection of Soda mattress with up-stream one
5) Row of connected mattresses
6) Putting rubble stones on mattress by wire straw-basket
Foot Protection Work
- Installation of Soda Mattress-

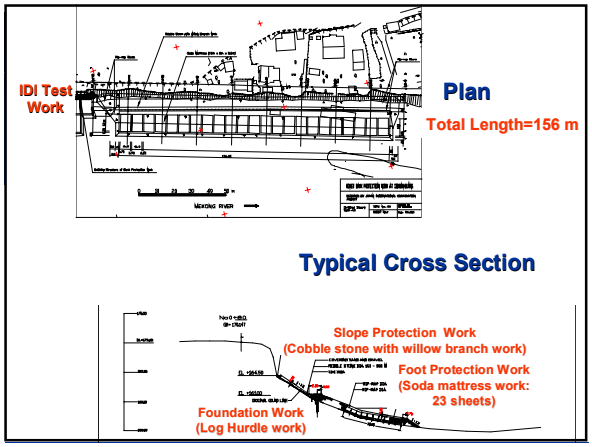

1) Embankment work by bulldozer
2) Compaction of slope and Kogui piling
3) Hurdle work using 'Taisya' and Siki-soda placing
4) Sand and gravel placing in Taisya hurdle (T=20cm)
5) Cobble placing by manpower
6) Finishing work: adjusting cobble by manpower
Slope Protection Works
- Cobble Stone with Willow Branch Works -


Construction of Green Park on Ban Dongphosi Site by JICA Laos Office (Mar. 2004)


Wat Chom Cheng Site
After Construction (Jan. 2004)
Before Construction (Feb. 2002)


Plan
Total Length=240 m
6 groynes
(3 of them: reinforced by 9 Soda mattresses)
Spacing:
40 m (upstream stretch)
60 m (downstream stretch)
Length of the groyne: 20m
Typical Cross Section


1) Preparation of wooden pile by sharpening tip of log
2) Transporting to the wooden piles by Barge
3) Piling work by Backhoe (Pushing down)
4) Piling work by Backhoe with attachment to vibrate and hit a wooden log
5) Lateral view of piled wooden logs
6) Riprap on the slope around connecting piles
Foot and Slope Protection Works
- Wooden Pile Groyne Work -



4. Test of Simple Vegetation Test Works

- High-cost works is unrealistic for the banks forming continuous vertical cliffs with low important riverine area.
- Simple vegetation test works *by willow planting*: possible measures to fix such bank soil *by people's involvement*.
- Cost: extremely low (US$ 10~50/m)
- Test works was executed in assistance with National University of Laos.

5. RIVERBANK PROTECTION MASTER PLAN

Objective of Master Plan (M/P)

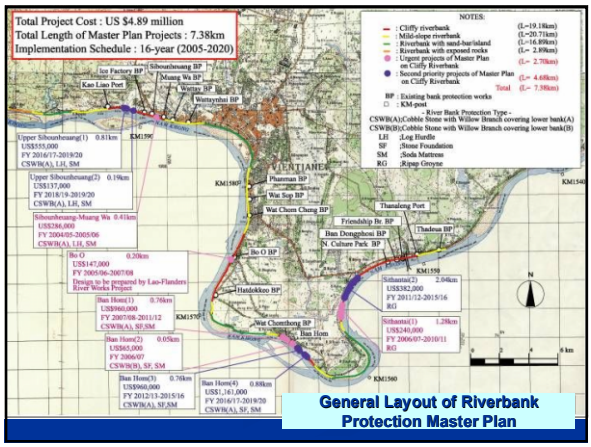
- Principles and guideline for the bank protection activities around Vientiane City:
  - to be implemented by the Government of Lao P.D.R. (GOL) by themselves using national budget in principle after 2005, and
  - introducing traditional river works of Japan in principle.

Outline of Master Plan (M/P)

- Target Year: 2020
- Total Project cost :US$4.89 million
  (national budget in principle)
- Total length of M/P projects: 7.38 km
  - 5 Urgent Projects: 2.70 km
  - 5 Second Priority Projects: 4.68 km
- Implementation Schedule:
  16-year (2005-2020)

Average Construction Cost of M/P by Work Type

	Construction Method	Average Cost (US$/meter)
1	Conventional Gabion Works implemented around Vientiane City	2,000
2	Work Types proposed in the Master Plan	
(1)	Riprap groyne work (L=20m, interval=150m)	100
(2)	1) Cobble stone with willow branch work covering upper bank 2) stone foundation and 3) soda mattress	1,300
(3)	1) Cobble stone with willow branch work covering lower bank 2) stone foundation and 3) soda mattress (in every other)	1,200
(4)	1) Cobble stone with willow branch work covering upper bank, 2) log hurdle work and 3) soda mattress	700
3	JICA Pilot Works (Reference)	
(1)	Ban Dongphosi Site	1,690
(2)	Wat Chom Cheng Site	200
(3)	Sibounheuang Site	810



General Layout of Riverbank Protection Master Plan

Basic Principles of Protection Measures of Master Plan

Type of Riverbank	Classification of Cliffy riverbanks	Length (km)	Principles of Bank Protection Measures
1) Cliffy Riverbanks	Existing riverbank protection works	3.15 (5.3%)	to be monitored and rehabilitated by GOL (O&M).
	Objective for Urgent Projects of M/P	2.70 (4.6%)	by GOL (2004/2005 - 2011/2012)
	Objective for Second Priority Projects of M/P	4.68 (7.9%)	*by GOL (2011/2012 - 2019/2020) * by people's involvement until the start of the Projects by GOL
	Remaining Stretches	8.65 (14.6%)	*by GOL after 2020/2021 *by people's involvement as the need arises
Sub-total	19.18 (32.4%)		
2) Mild-slope riverbanks	20.71 (35.0%)		*no active erosion in general *by people's involvement as the need arises
3) Riverbanks with sand bar and island	16.89 (28.5%)		No need specific bank protection activities
4) Riverbanks with exposed rocks	2.46 (4.2%)		
Total	59.24(100%)		

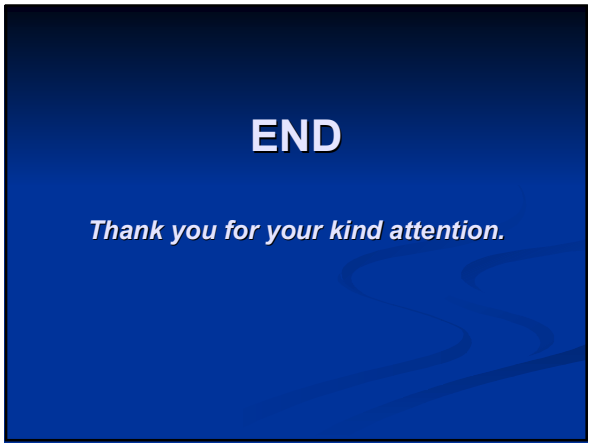
6. GOL Activity from 2005

- Proposed *"Mekong Riverbank Protection Unit"* in MCTPC will start:
  - the construction of the following M/P projects using national budget
  - the maintenance works including the Pilot Works
- Taking budgetary steps based on the M/P

Investment/ budgeting plan of M/P (early stage)			
Fiscal Year	Budgeting Plan (Investment Plan) <US$1,000>	M/P Projects	Length of Construction (m)
2004/2005	235 (160)	•Sibounheuang - Muang Wa	200
2005/2006	249 (210)	•Sibounheuang - Muang Wa •Bo O Total	210 60 270
2006/2007	265 (184)	•Sithantai (1) •Ban Hom (2) •Bo O Total	250 50 70 370

7. JICA Follow-up Plan from 2005

- Government of Japan plans to start follow-up *"Technical Cooperation Project"* from 2005 to assist the implementation of the M/P projects by GOL as follows:
  - 1) Dispatch of a JICA project team
  - 2) Acceptance of GOL trainees to Japan
  - 3) Provision of equipment for bank protection
    - equipment for river survey works
    - equipment for Soda works
    - OA equipment
- This subject will be discussed in detail on October 13 and 14.


END
Thank you for your kind attention.