

7.3 Component 3: Watershed Rehabilitation and Conservation

7.3.1 Identification of Programs and Objectives

In the management of natural environment in the Musi River Basin, watershed rehabilitation is the most important measure to achieve the following objectives:

- To decrease flood, and to stabilize water regime
- To decrease soil erosion in the watershed and hence reduce sedimentation in rivers
- To conserve and rehabilitate ecological resources
- To increase groundwater resource

As direct actions against soil erosion, the Plan proposes three programs: **1)** reforestation on land with major constraints for agriculture development, **2)** law enforcement on production forest (HP) and logging in general, and **3)** inner- and inter-basin coordination of policies and projects.

For healthier, sustainable natural environment in the future, the Plan also proposes additional three programs for conservation within the watershed: **4)** forest area increase, **5)** conservation of river environment, and **6)** conservation of swamp and mangrove forest.

These six programs cover most part of the Province. The following **Figure 7.3.1** shows conceptual locations of project target areas. **Figure 7.3.2** explains overall scheme for rehabilitation and conservation of the river basin.

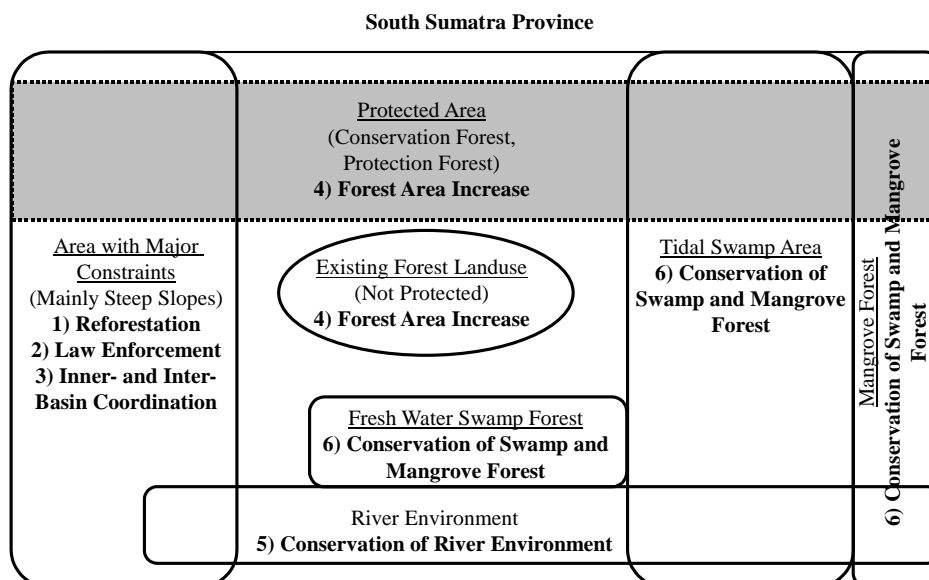


Figure 7.3.1 Conceptual Map of Target Areas

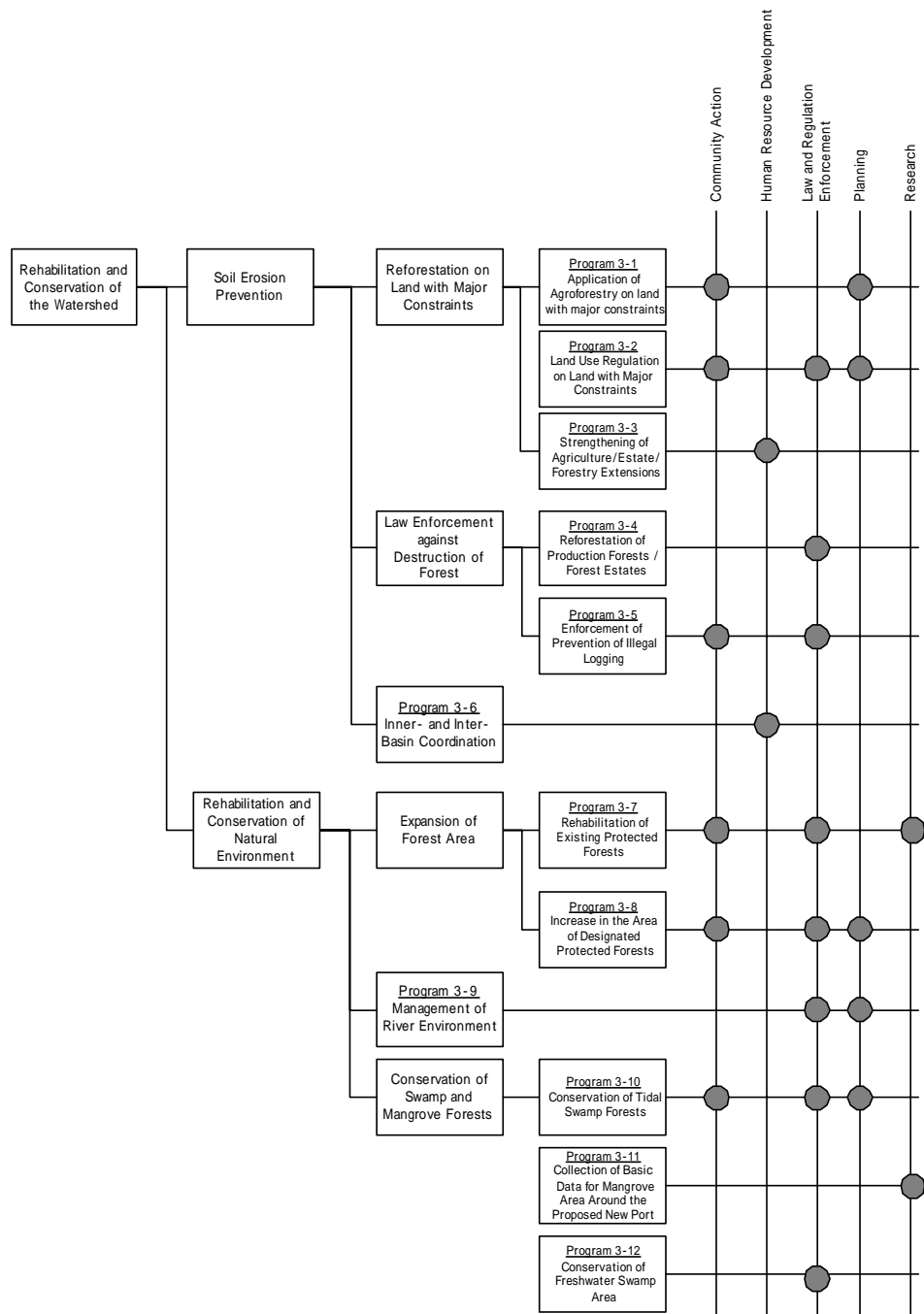


Figure 7.3.2 Overall Scheme for Rehabilitation and Conservation of the River Basin.

Watershed rehabilitation and conservation is closely related to the other sectors. Institutional strengthening and monitoring network establishment are essential bases, and desirable prerequisites for implementation and monitoring of natural environment conservation. Floodplain management and water use management may cause both positive and negative impacts on water environment and environment in the area between water and land, such as swamps and mangroves.

7.3.2 Soil Erosion Prevention -Reforestation on Land With Major Constraints-

This sub-section discusses reforestation on land with major constraints as a part of soil erosion prevention. The objectives are: to introduce better land management on the most critical areas within the Musi River Basin, and to convert garden-type land use on steep slopes to forest-type land use.

Leading institutions shall be; Kabupaten-level and Kecamatan-level forest, estate, and agriculture office, and extension offices, in cooperation with Provincial offices. Also, Provincial- and Kabupaten-level BAPPEDA shall be responsible for legislative action for land use regulation. Forest rehabilitation and community involvement in such action is now experimented in the Kerinci Seblat National Park. Researchers and NGOs involved in such an action are expected to take further leading role within the Musi River Basin.

Duration of the project shall be as follows: Preparation of land use regulation will need discussion with Kabupatens, and may take 3 years. Drawing and formalizing the regulation may need 2 more years. Public hearing and consultation at areas that will be subject of the regulation must be started during these 5 years. After the first 5 years, detailed zoning of the target area will start, followed by projects for land use change and modification of agriculture technology (**Figure 7.3.3**).

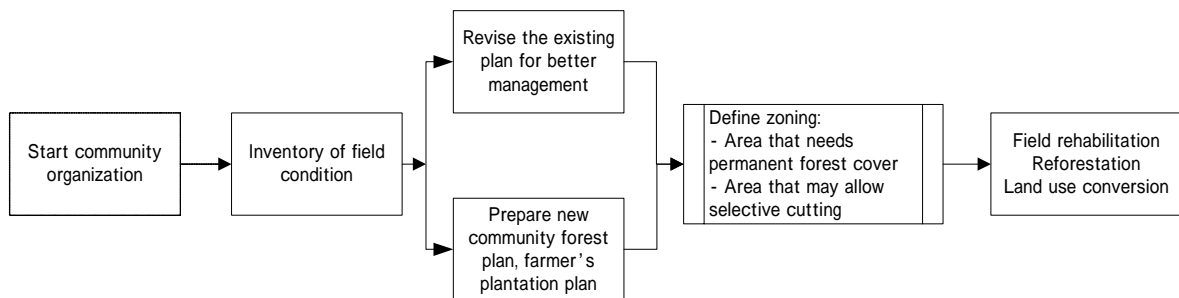


Figure 7.3.3 Introduction of Agroforestry on Land with Major Constraints

The Musi River Basin Study (December 1989) found land unsuitable for agriculture in the area. The area is shown in **Figure 7.3.4** and breakdown by Kabupaten is shown in **Table 7.3.1**. Existing land use types within the area is predominantly the farmer's plantation (Perkebunan Rakyat) (**Figure 7.3.5**). When divided into the sub-basins, however, each sub-basin has specific character (**Figure 7.3.6** and **Table 7.3.2**).

Project target for erosion prevention in the land with major constraints should, therefore, concentrate on farmer's plantation area. Priority areas area recommended to be chosen

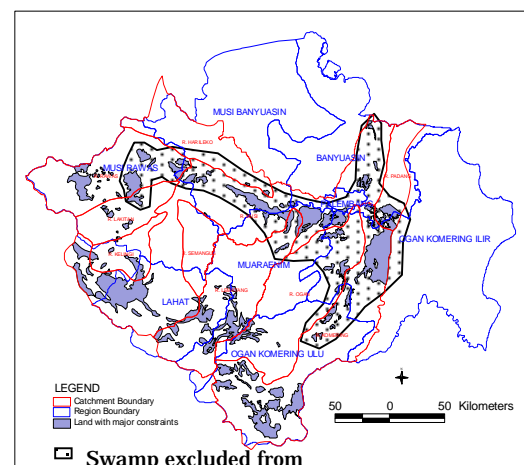


Figure 7.3.4 Land with Major Constraints (Not Suitable for Agricultura Use)

from areas that already have plan for farmer’s plantation development, and areas that have community organization to prepare or implement such plan. Plantations must also be included as target area in sub-basins of Rawas (big plantation area), Musi (Forest plantation and mixed garden), Lematang (Mixed garden), Ogan (Forest plantation and mixed garden), and Komering (Forest plantation and mixed garden). Owners and operators of these plantations must be notified the limitations of their land for better management and sustainable production of the areas.

Table 7.3.1 Land Area that has Major Constraints by Sub-Basin

Sub-Basin	Sub-Basin Total (km ²)	Area with Major Constraints (km ²)	Area with Major Constraints (%)
Rawas	6,026	331.85	5.5%
Lakitan	2,763	115.83	4.2%
Harileko	3,765	8.59	0.2%
Musi	15,320	1,498.57	9.8%
Kelingi	1,928	153.27	7.9%
Lematang	7,340	589.52	8.0%
Ogan	8,233	290.09	3.5%
Komering	9,908	801.69	8.1%
Padang	2,513	68.31	2.7%
Total	57,796	3,410.04	5.9%

Source: Musi River Basin Study, Final Report, Annex No. 3 page 6-8, Republic of Indonesia, Ministry of Public Works, Directorate General of Water Resources Development, and Commission of the European Communities, December 1989, Consultancy Contract No. HK 020301-Da/1148

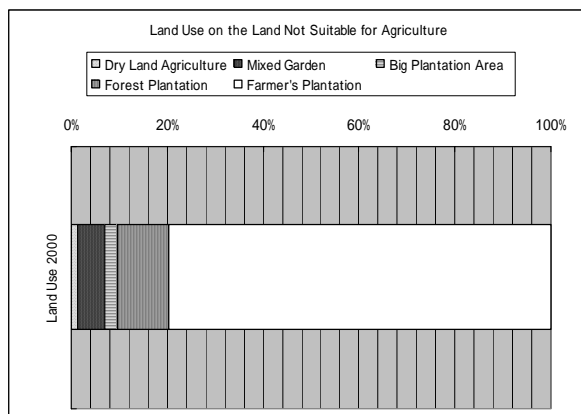


Figure 7.3.5 Land Use Types within the Constraints Area

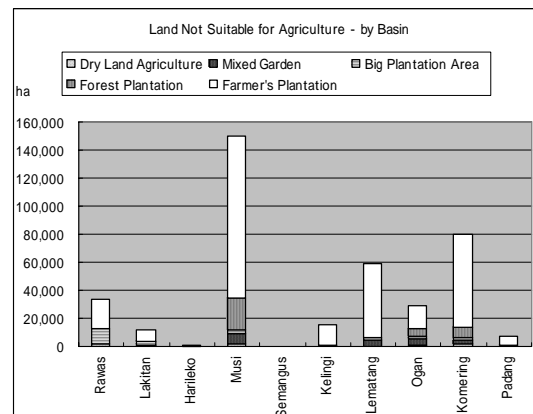


Figure 7.3.6 Land Use Types within the Constraints Area by Sub-Basin

Application of Agroforestry on Lands with Major Constraints (Program 3-1)

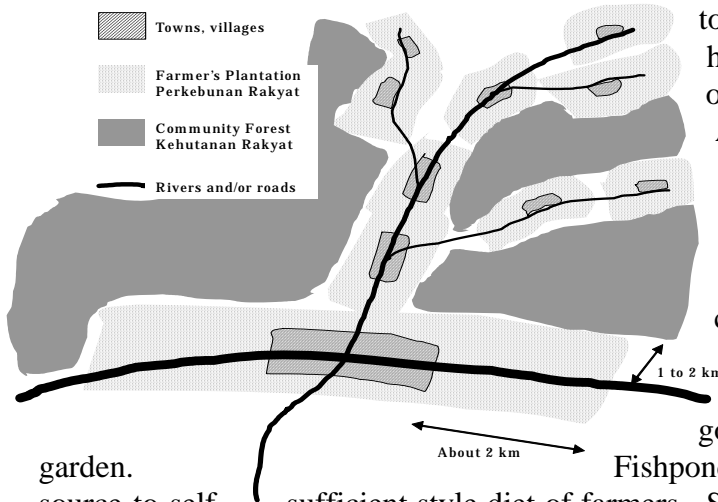
Farmers who are using the land with major constraints are encouraged to introduce agroforestry (tumpang sari) method in their garden (pertanian rakyat), mixed garden, and estate (perkebnan rakyat) (see **Figure 7.3.7**). By this conversion, farmers can obtain various food crops near their house with less labor, and some crop for market for cash income. Currently, such lot is used mainly for rubber and coffee, and market-keen

farmers often cut down their trees and change their strategy for income. Introduction of agroforestry lower farmers' temptation for this short cycle of tree cutting.

Also, farmers must receive stronger education of agricultural technology about farming on slope for their individual plantation. Technique for soil conservation, such as terracing, alley cropping and check dam must be applied by all farmers on slope. As an effective measure for soil conservation, no-tilling farming is gaining popularity in many countries in the world, including those in tropical climate. The technology keeps roots and other remnants of crop on or in soil as mulch cover. Farmers either dig holes or do light tilling for next crop. By this method, soil is covered most of the year, and nutrients are kept there.

Slope more than 15 % is recommended for conversion to permanent forest. Farmers

Figure 7.3.7 Conceptual Relationship of Road, River, Village and Farmer's Plantations



must be educated so that they themselves can measure the steepness of slope with simple

tools. Non-wood products such as honey, latex, and spices may be obtained from the permanent forest. Agroforestry is a traditional, self-sufficient style of farming in West Java area. Each household is surrounded by a home garden, where many different crops from coco, banana, yam, or cassava are grown. Firewood is collected in home gardens too. Hens and goats may be raised in a part of the

garden.

source to self-sufficient style diet of farmers. Such home gardens can be found in South Sumatra Province in old transmigration area where people from Java area are relocated. Fishpond is also common to add protein

Land Use Regulation on Land with Major Constraints (Program 3-2)

The area of land with major constraints must be recognized in Kabupaten and Provincial level spatial plan. The spatial plan must also state a list of suitable land use (ex. permanent forest) for the area. The draft of the plan must be explained to all the stakeholders and communities possibly affected by the designation. The scientific base of the regulation must be well explained, and mitigating measures for impact on local economy must be sought both by the government and local community.

To realize the plan, a land use regulation ordinance regarding the area must be prepared and activated. Based on the regulation, local government should start community projects for tree planting, terrace preparation, check dam construction, and other prevention measures against soil erosion. **Figure 7.3.8** explains the steps of action.

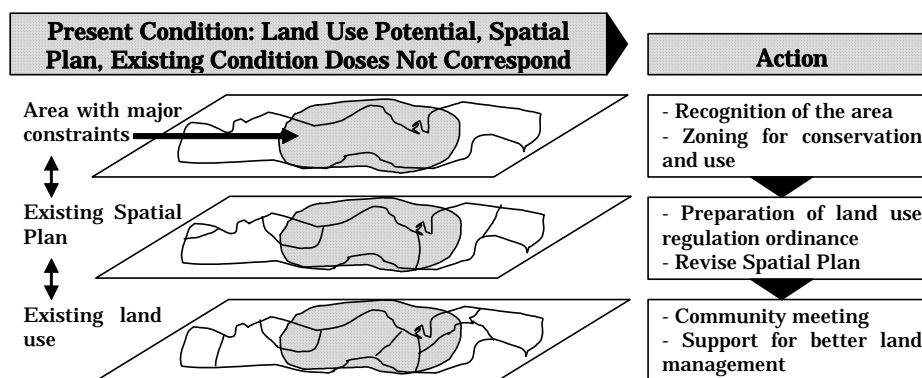


Figure 7.3.8 Land Use Regulation on the Land with Major Constraints

Strengthening of Agriculture/Estate/Forestry Extensions (Program 3-3)

In the autonomy society, government office that directly face local residents need to play the most important function. It is expected to gather opinions of residents, at the same time to provide information about policies and projects of the government. For better land management, integrated consulting must be provided for farmers. Such consulting may cover technique for collecting non-tree crops from permanent forest, site preparation, terracing, and living fences. In past decades, such consulting has been provided to individual farmers through small, government-supervised demonstration projects at extension offices.

In the year 2000 (pre-autonomy), there were 89 agriculture extensions in South Sumatra Province (number of forestry extension was not available) (Table 7.3.2). In average, each office had 21 staff (including Rank II to other). Given that agriculture land use (dry land agriculture, farmer's plantation, mixed garden, rice field) amounts 30,752 km² in the Province, each office is expected to supervise 346 km², or 19 km² for each staff (Rank II to Rank IV). (If farmer's plantation is excluded, 78 km² for one office and 4.3 km² for one staff)

Table 7.3.2 Number of Office and Staff of Agriculture Extension by Regency Year 2000

Location	Office	Rank II	Rank III	Rank IV	Other	Total
Musi Banyuasin	17	305	30	0	59	394
Ogan Komering Ilir	11	187	69	0	52	308
Ogan Komering Ulu	16	284	44	1	32	361
Muara Enim	15	127	35	0	16	178
Lahat	14	145	37	0	35	247
Musi Rawas	13	207	45	0	35	287
Palembang	2	40	27	0	0	67
Province	1	0	28	6	0	37
Total	89	1,295	315	7	229	1,846

Source: Statistik Tanaman Pangan p. 106, 107

To fulfill the expected task of the extension, each office shall consist of at least four units: Planning and logistics, Monitoring, Demonstration Field and Nursery, Production/Communication/Consultation. Since the staff need to know the local people and their economic condition well, it is best to hire them from local community (Figure 7.3.9). Management of nursery may also create jobs in local community. The monitoring also

will benefit from the experience of locals. Transfer of information on environmental condition is also expected by hiring local residents for such positions.

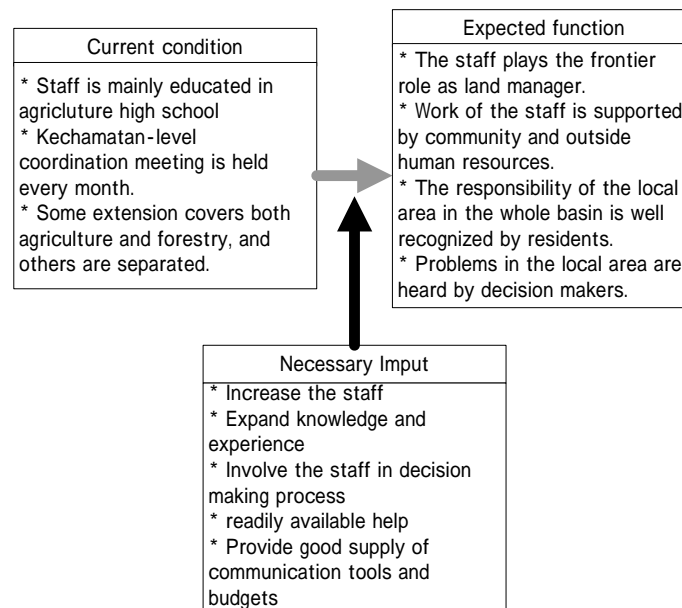


Figure 7.3.9 Expected Function and Necessary Input for Agriculture/Estate/Forestry Extensions

7.3.3 Soil Erosion Prevention -Law Enforcement against Destruction of Forest-

Law enforcement against destruction of forest is a part of soil erosion prevention and consists of two programs, namely, Reforestation of Production Forest, and Enforcement of Prevention of Illegal Logging.

Reforestation of Production Forest and Forest Estate (Program 3-4)

The objective of the program is: to make sure that the obligation of reforestation by the forest companies are fulfilled as intended, and to rehabilitate forest resource of the Province for sustainable use in the future. More concretely, this program is to enforce reforestation obligation at Production Forests and Forest Estates. Every concessionaire of the Production Forests and Forest Estates in the Province receives logging concession from the Provincial Forest Office. When a concessionaire makes contract for secondary forest that was logged already, the concessionaire receives reforestation fund (DR). The money is given prior to the reforestation action, and an international organization, ITTO, found that reforestation is not realized. Therefore, the fund is not functioning, money is wasted, good forest land is left devastated.

This project is to legalize inspection and monitoring by the Province, the concession provider, on reforestation activities by the concessionaire, or the previous concessionaire. The total area of Production Forests covers 25 % of the Province. Just management is essential for safe and prosperous life in South Sumatra for long term (Table 7.3.3).

Table 7.3.3 Production Forests in South Sumatra Province

Type	Area (km ²)	Forest with Limited Production	Production Forest	Conversion Forest	Total Number	Total Area (km ²)	%
MuBa	26,191	2	11	8	21	8,487.77	32%
MuRa	21,513	1	8	5	14	3,780.10	18%
Lahat	7,719	2	2	0	4	536.28	7%
MuEn	9,575	1	4	0	5	2,861.07	30%
OKI	21,367	1	5	9	15	8,438.99	39%
OKU	14,679	2	5	0	7	1,116.13	8%
Total	101,044	9	35	22	66	25,220.34	25%

Source: Statistik Kehutanan, Propinsi Sumatera Selatan 2001, VI-1

Leading Institution shall be Provincial Forestry office, in cooperation with Forest Police, Kabupatens, and forestry extension offices in each Kecamatan. Provincial Forest Office will need close communication with existing and former concessionaire and their business associations to share understandings of the common merit of reforestation. Provincial Forest Office may also need to report to and consult with Ministry of Forestry to establish stronger legal action to monitor the use of Reforestation Fund.

Duration of the project shall be: preparation of the project for three years, and monitoring and reforestation execution will follow. The project area shall be as follows: There are about 25,220 km² production forests in the Province. The area is divided into 66 locations (**Table 7.3.3**). Of these, all areas that have received the Reforestation Fund must be investigated. Areas, however, that falls in either one of following three criteria may be considered as special priority sites: 1) those that directly located along the major tributaries, 2) those on the land with major constraints, or on steep slopes, and 3) those that located next to protected forests (HSA and HL). Names of these priority sites for inspection are listed in **Table 7.3.4**. Priority also may be given to Kabupatens that expressed stronger concern for their own natural resource, and willingness to cooperate in the investigation.

Table 7.3.4 Priority Sites for Investigation for Reforestation*

Priority Criteria	Province	Name
Directly located along the major tributaries	MuBa	HP Mangsang Mendis
On the land with major constraints, or on steep slopes		HP Rawas Utara, HP Rawas Lakitan, HPT Rawas Lakitan, HP/HPT Bukit Balai, HP Gumai Tebing Tinggi, HPT Isau Isau, HP Air Empelu, HP Bukit Asam, HPT Saka
Located next to Protected forests	MuRa	HPT Rawas Lakitan
	MuBa	HPT Meranti S. Kapasis Saka Suban, HPT Meranti LB Buah, HP Meranti S. Bayat S. Bahar, HP Meranti S. Merah, HP Mangsang Mendis, HP Sungai Lalan
	Lahat	HP/HPT Bukit Balai, HPT Gumai Tebing Tinggi, HP Bukit Asam
Located next to Protected Forests	MuEn	HPT Isau Isau, HP Air Empelu
	OKI	HP Simpangheran Beyuku**, HP Mesuji III**
	OKU	HPT Air Tebangka, HPT Saka, HP Saka

Note: *: Table does not include Conversion Forests because individual name was not given in the Forest Plan Map.

** : Located outside of the Musi River Basin.

To secure the required reforestation done, three types of policies need to be implemented: 1) Guidance and communication, 2) Encouraging actions for reforestation, and 3) Enforcing actions. Components of these actions are explained in **Table 7.3.5**.

Table 7.3.5 Actions for Reforestation of Production Forests

Guidance and communication	
<ul style="list-style-type: none"> * The Province must make sure that all forest company that obtain concession in the Province has sufficient number of reforestation staff in local offices. The staff must be educated and trained well according to the ITTO international guideline for rehabilitation and reforestation of tropical forests. * An investigation team must be formed to evaluate the achievement of concessionaire, as well as to discuss better systems to encourage sustainable forest production. The team should include members from forest industry, forestry research, environmental NGOs, and provincial and local government. 	
Encouraging Actions	Enforcing Actions
<ul style="list-style-type: none"> * Corporation that achieved its reforestation obligation is given priority consideration at renewal of concession. * Additional grant may be considered to support maintenance work for reforestation. 	<ul style="list-style-type: none"> * The timing of DR payment must be delayed to after completion of reforestation. * Sabotage fine must be charged for those received the DR but missed to achieve agreed reforestation. * Names of the companies that failed obligatory reforestation must be announced in mass media. * Log production allowance must reflect amount of reforestation work achieved. Those failed to realize obligatory area/ number must be limited their production.

Enforcement of Prevention of Illegal Logging (Program 3-5)

The objectives of the program are; to create atmosphere in local community against illegal logging activities, and to catch and punish those that involve in illegal logging activities. More concretely, this program is to minimize logging activities without proper concession. Illegal logging may be defined in four types as described in **Table 7.3.6**.

Table 7.3.6 Types of Illegal Logging

Location	Condition
Production Forest	Log cut with improper license, or without any license.
Protected forest (HSA, HL)	Any tree cut down without proper permission.
Farmer's plantation or private land	Log cut and transported without proper recognition of village leader.
Forest or tree stands without any legal designation	Any tree cut down without proper permission.

Since national moratorium for logging is in effect, all logging concession in the Province besides those for pulp industry has been stopped in 2002. However, the concession system itself has had some problems. The ITTO technical mission to Indonesia in 2001 recognized that cutting permits can be issued by various authorities (district, provincial and central). There have even been cases where cutting permits have been issued for the same area by different authorities to different parties. It is reported that most loggers are not local residents, but chain-saw men hired by corporations in wood industry in Palembang or other areas.

Leading Institutions shall be Provincial Forestry Office and Forest Police. Daily patrol and alert raising effort need cooperation of local residents and local government. Center for International Forest Research (CIFOR), Bogor has good experience in research and proposal against illegal logging. It would be of great help to have help from the Center to coordinate local plan and training of monitoring staff. Fundamental achievement to halt illegal logging needs restructuring of political and economic situation in Indonesia. Severe loss of local natural resource cannot wait for such long-term social change. This plan tries to do what can be done just by local people and their government.

Duration of the project shall be: Coordination of investigation team and planning of work may take three years. Investigation and community education will follow. Project area shall be: Since most of remaining forest is now located in remote area in mountain and swamp, illegal logging activities area reported from these areas as well. In that case, target area may be Kabupatens Banyuasin, OKI, MuRa, Lahat, and OKU. Priority also may be given to Kabupatens that expressed stronger concern for their own natural resource, and willingness to cooperate in the investigation. Since the Province is wide and population is sparse, it is difficult to monitor logging activities in remote area. Effort must be concentrated on measures that can take place close to where people live.

The project component shall be as follows: The Five Year Strategic Plan for Forestry Development 2000-2004 lists following projects in its priority list (**Table 7.3.7**). Major tasks that should be realized in the Province are described in **Table 7.3.8**.

Table 7.3.7 Actions for Reforestation of Production Forests

No				Program
III.	1	1. 3	b.	The development of illegal logging prevention and supporting facilities, infrastructures also followed up by result of securing activity (fast justice processing)
III.	1	1. 3	c.	The empowerment, utilization and availability of PPNS of Forestry, forestry police and PPKBRI
III.	1	1. 3	f.	Information and guideline for society to support activity successful of illegal logging and illegal trade combatant.

Source: Rencana Strategis Pembangunan Kehutanan, Propinsi Sumatera Selatan, Tahun Dinas 2000-2004

Table 7.3.8 Examples of Measures against Illegal Logging

License control	* Kabupatens and Province monitor and control licensing activities, over-rule and stop any licensing that is against the moratorium policy.
Education and community organization	* Local communities near illegal logging site must be given information about how logging on steep slope increase threat of flooding and landslide. * Local residents must be encouraged to report any illegal or suspicious activities to Provincial Forest Office or other appropriate public offices.
Patrol and police work	* In mountain area, access to forest is limited to certain roads. In swamp area, logs are cut and stored in small canals or rivers in dry season, so that they can be flush out in wet season. By patrolling in such limited area, evidences of logging activities will be collected, and arrests may be made with less effort.
Counter-action	* Loggers usually construct wooden log-road in forest to pull the cut log on it. Destroying such log-road repeatedly would express local decision to fight with the loggers and discourage logging activity.

7.3.4 Soil Erosion Prevention -Inner- and Inter-Basin Coordination-

Soil Erosion Prevention -Inner- and Inter-Basin Coordination (Program 3-6)- has been proposed. The objectives are: to realize sound and comprehensive resource management, and to encourage local government to manage their own land and water resources in coordination with other government body within the same sub-basin. The program is to organize and practice inter-sector coordinating body (PPTPA) for the Basin, and to organize and practice sub-basin level coordination so that local interest and problems are better reflected to the decision making of the whole Basin.

For formation of Musi River Basin PPTPA, leading institution will be the Governor's Office, in cooperation with various related provincial office, academic researchers, and NGOs. For sub-basin level organization, leading institution will be Kabupaten, with help from Provincial Governor's Office, and the PPTPA itself. Member of sub-basin level organization will consists of similar combination as the PPTPA, but of local level.

Formation of sub-basin or Kabupaten level organization may be started prior to the PPTPA, or after, depending on willingness of Kabupaten. For the PPTPA, the project area is the whole Musi River Basin. Since the whole basin is so large, it is difficult for representatives of Kabupaten to gather often at one place, also, specific interests of each region will make discussion at the PPTPA difficult to focus on particular issues.

For better communication, concentrated efforts for resource management, and for empowerment of local autonomy, the Plan proposes to establish Kabupaten or sub-basin level inter-sector organization. For example, sub-basins are grouped in **Table 7.3.9** by their common concern in water and land resource problems (see also **Table 7.3.10**.)

Table 7.3.9 Sub-Basins and Shared Concerns

Groupings of Sub-basins	Shared Concerns
Rawas, Lakitan	National Park management and control of logging and encroachment
Lematang	Water resource conservation for urban and industrial water needs
Musi, Harileko, Semangus, Kelingi	Water resource conservation
Ogan, Komering	Reduction of sand deposition, increase of water flow

Table 7.3.10 Kabupatens and Sub-Basins

	Rawas, Lakitan	Lematang	Musi, Harileko, Semangus, Kelingi	Ogan, Komering
OKU				O
OKI				O
MURA		O	O	
Lahat	O	O		
Muara Enim	O	O		
MUBA		O		
Banyuasin			O	
Palembang			O	
Perabumulih		O		
Lubuk Linggau		O		
Pagaralam		O		

The organization will consist of public offices, local communities, and NGOs, related to spatial planning, forestry and conservation, agriculture, water resource management and other related sectors (**Figure 7.3.10**).

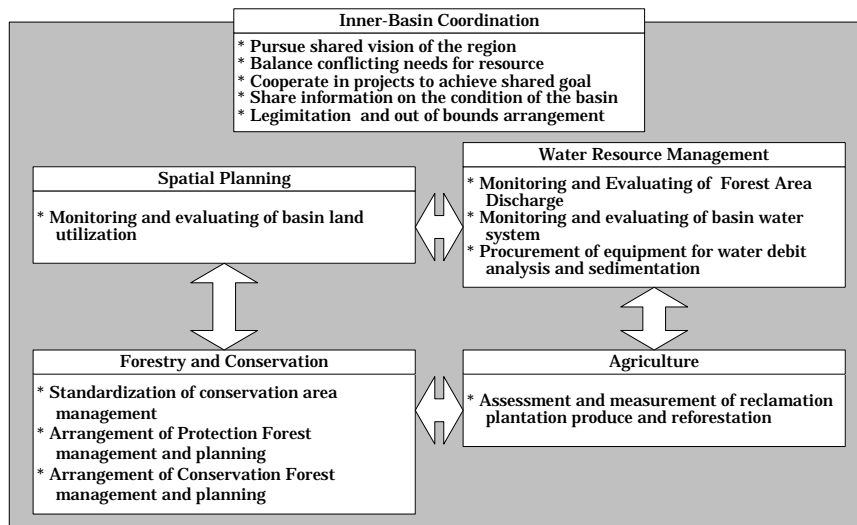


Figure 7.3.10 Image of Coordination within Inter- and Inner-Basin Organization

This project aims to form such inter-sector organization at Province and local level, to have broad information shared in the organization, and to form, implement, and monitor land management projects that handle the local issues. To make the organization function, the organization and its members must be given authority and responsibility to propose inter-basin projects, implement and monitor the projects, and report the achievement (**Figure 7.3.11**).

In Indonesia, watershed rehabilitation and conservation is in progress in some basins. There is designation for areas for reforestation by "List of Priority River Basins for Reforestation (Ministry of Forest – Kimpraswil)" and "River Basins for Reforestation and Rehabilitation on SK21 (Ministry of Forest)", the Musi River Basin, however, is not included in either list.

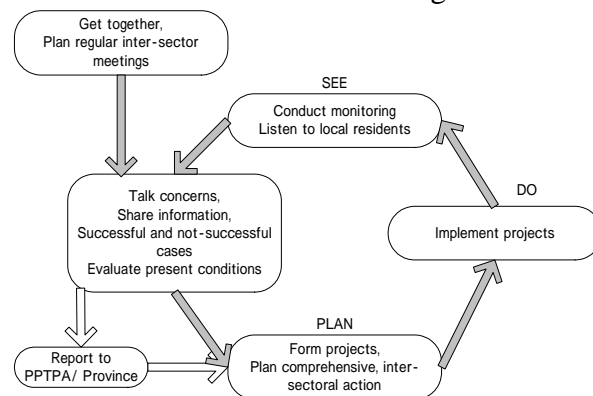


Figure 7.3.11 Actions Expected for Inter- and Inner-Basin Organization

7.3.5 Rehabilitation and Conservation of Natural Environment -Expansion of Forest Area-

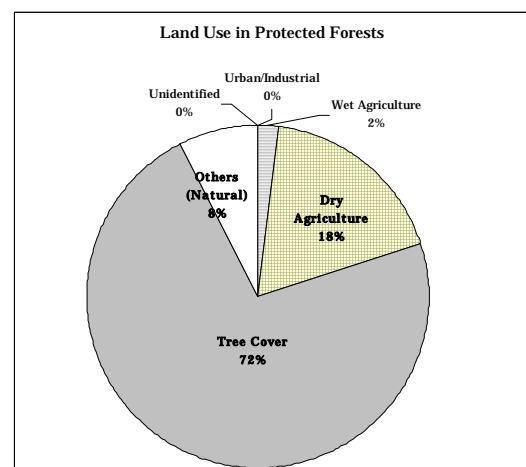
Rehabilitation of Existing Protected Forests (Program 3-7)

The objectives of the program are: to cover the designated area with tree species native to the locations, and to rehabilitate biodiversity within the designated protected areas. Leading institutions shall be; for HSA, National Balai KSDA and Provincial Forestry

Office; and for HL, Kabupatens in cooperation with Provincial Forestry Office. Duration of the project shall be: Upgrade planning with involvement of extension officers for three years. Implementation will follow.

Project area shall be within the existing Conservation Forests (HSA), and Protection Forests (HL). As in **Figure 7.3.12**, 80 % of the area of HSA and HL is covered by natural land use. The rest of 20 %, or 1,555 km² is the target area for reforestation. Also, forest land use of 8,477 km² (72%) is the target area for rehabilitation of natural habitat.

Table 7.3.11 shows that existing forestland use in the Province is much smaller than legally protected forest area. Rehabilitation of forest stands at least within the legally designated area will substantially increase the ratio of forest cover in the Musi River Basin.



Source: Land Use 2000

Figure 7.3.12 Land Use in Protected Forests

Table 7.3.11 Area of Sub-Basins and Ratio of Protected Forests

Sub-Basin	TN, HAS (km ²)	HL (km ²)	Protected Area Total (km ²)	Sub-Basin Total (km ²)	Protected (%)	Forest Land Use Area (km ²)	Forest Land Use (%)
Rawas	1,663.59	0	1,663.59	6,026	28%	315.10	5.2%
Lakitan	748.45	20.65	769.10	2,763	28%	109.02	3.9%
Harileko	175.19	192.37	367.56	3,765	10%	8.59	0.2%
Musi	511.07	785.55	1,296.62	15,320	8%	1,409.18	9.2%
Kelingi	42.92	9.55	52.47	1,928	3%	148.14	7.7%
Lematang	190.83	1,045.76	1,236.59	7,340	17%	548.40	7.5%
Ogan	.13	562.01	562.14	8,233	7%	237.83	2.9%
Komering	.00	1,046.97	1,046.97	9,908	11%	752.34	7.6%
Padang	587.67	190.58	778.25	2,513	31%	64.19	2.6%
Total	3,919.85	3,853.44	7,773.29	57,796	13%	3,592.79	6.2%

Source: Protected Area: Provincial Forestry Office
Forest land use area: Land Use 2000

Sub-basin area: Progress Report Annex 2.7.1

For rehabilitation of protected forest, six actions are needed for simultaneous implementation. They are, 1) forest border construction, 2) forest rehabilitation (priority on where currently not covered by tree vegetation), 3) habitat rehabilitation (priority on where tree vegetation remains), 4) law enforcement, 5) human resource development, and 6) monitoring and research (**Table 7.3.12**).

As of 2001, there are a total of 60 staffs of Balai KSDA for management of protected forests. They are stationed at seven locations (**Table 7.3.13**). Considering whole protected forest, however, simple calculation tells that one staff is responsible for 129.55 km² of protected forest in average. Number and training of station staff is the key to successful rehabilitation of protected forest.

Table 7.3.12 Project Components for Rehabilitation of Protected Forest

Forest Border Construction	Reconstruction of Forest Area boundary
	Maintenance and secure of Forest Area boundary
Forest Rehabilitation	Maintenance of area, which is forest fire/ cutting wood/ damaging/ illegal digging, which is already rehabilitation year before.
	Rehabilitation of conservation area that already damage by natural or artificial succession and make priority for local plant.
Habitat Rehabilitation	Identification of concerning biodiversity potency in preserved area
	Perpetuation and rehabilitation of rare flora and fauna
Law Enforcement	Making of patrol road/ Zones border
	Making of spying tower (height ± 12 m, border ± 4 m2)
	Shelter construction (12 m2)
	Gate construction
Human Resource Development	Arrangement planning of preserved forest management unit
Monitoring and Research	Habitat guideline
	Evaluation of conservation area function
	Inventory of preserved area

Table 7.3.13 Number of Staff at Conservation Forest 2001

Location	Civil staff	Forest police	Other	Total
HSA. Padang Sugihan	2	9	0	11
HSA. Bentayan	2	5	1	8
HSA. Dangku	2	5	0	7
HSA. Gumai Pasemah	3	6	0	9
HSA. Isau-Isau Pasemah	2	5	2	9
HSA. Sungai Sembilang	2	7	1	10
PLG/TWA. Bukit Serelo	4	2	0	6
Total	17	39	4	60

Source: Balai KSDA Sumatera Selatan

Increase in the Area of Designated Protected Forests (Program 3-8)

The objective is to include as much remaining tree stands within protected areas. The program includes; identification of remaining forest area, and expand existing borders and new designation of Protected Forests

Leading institutions shall be as follows: Provincial Forestry Office shall conduct Identification in cooperation with National Nature Conservation office (Balai KSDA). Dishut Kabupaten (Kabupaten-level forest office) and Desa-level Penyuluh (extension) shall conduct detailed identification and coordination with landowners. Kabupatens and Kecamatans must be encouraged to nominate local protection forests. Such local protection forests may include historical sites, area with religious or cultural importance. Area may be as small as a few hectares. Regulation of use in the area may be decided by local residents, as long as the area remains to be covered mostly by tall woods. Maintenance and patrol activities may also be conducted by local residents.

Forest identification may be revised every 5 years. Effort for new designation may continue throughout the target years. Forest identification will be done for whole Province outside of already protected forests (HSA, HL). Priority for identification work, however, may be set for one or more sub-basins or Kabupatens for quick

execution of the policy. Designation of protected forests may also concentrate on priority areas. Examples of priority consideration are summarized in **Table 7.3.14**.

Table 7.3.14 Priority Area for New Designation of Protected Forest

* Remaining forests within Freshwater Swamp Forests and Lowland Rain Forests eco-region definitely have priority to be conserved, since they are not currently protected. (see Table 7.3.15)
* Expansion of existing border has priority to new designation, since that will improve ecological function of existing protected forest. Where substantial forest is located close to already designated Protected Forest, but not yet protected legally, the existing border must be expanded to include such forest.
* Musi, Komerang, and Lematang sub-basin has the largest land area that has major constraints for any agriculture production. Such area with difficulties may better be included in Protected Forest System. (see Table 7.3.16)
* Ogan and Komerang Sub-Basins can be priority areas because they need urgent rehabilitation in terms of soil erosion.
* Kelingi, Ogan, and Musi sub-basin have least percent of protected area compared to the total area of sub-basin. (see Table 7.3.11)

Table 7.3.15 Area of Eco-Regions and Ratio of Protected Forests

Ecoregions		Montane Rain Forests	Lowland Rain Forests	Freshwater Swamp Forests	Peat Swamp Forests	Sunda Shelf Mangroves
Number of Protected Area	National park (TN), Conservation forest (HSA)	4	2	0	5	4
	Protection forest (HL)	6	6	0	0	6
Protected Area Total (km ²)		5829.66	726.28	0	4362.89	*
Original Area (approx. km ²)		10,104.40 (10 % of Province)	50,522.00 (50%)	3,031.32 (3%)	37,386.28 (Peat Swamp 35%, Mangroves 2%)	*
Protected %		58%	1%	0%	12%	*

*: Protected area and original area of peat swamp and mangrove are added in the table.

Table 7.3.16 Land with Major Constraints by Sub-Basin

	Sub-Basin Total (km ²)	Area with Major Constraints (km ²)	Area with Major Constraints (%)
Rawas	6,026	331.85	5.5%
Lakitan	2,763	115.83	4.2%
Harileko	3,765	8.59	0.2%
Musi	15,320	1,498.57	9.8%
Kelingi	1,928	153.27	7.9%
Lematang	7,340	589.52	8.0%
Ogan	8,233	290.09	3.5%
Komerang	9,908	801.69	8.1%
Padang	2,513	68.31	2.7%
Total	577,960	3,410.04	5.9%

Projects component shall be as follows: Data of the remaining forest may be obtained from the NOAA satellite images obtained daily for forest fire control. This project uses the data and takes a prevention measure against forest fire and forest clearance. Forest identification may be conducted mainly in Palembang. After the preliminary forest map is prepared, major task will be transferred to field, and the leading agency will be Kabupatens or Kecamatans. Project duration from on-site identification to commencement of forest conservation actions may take about 5 years.

It is very important that local communities are involved in the earliest stage into the designation process. Identification of forested area, inventory of forest resources are good opportunities for government to work together with local residents. The draft of forest plan must be explained to communities possibly affected by the designation. The scientific base of the regulation must be well explained, and mitigating measures for impact on local economy must be sought both by the government and local community. Steps for designation of new protected forest are summarized in **Figure 7.3.13** and **Table 7.3.17**.

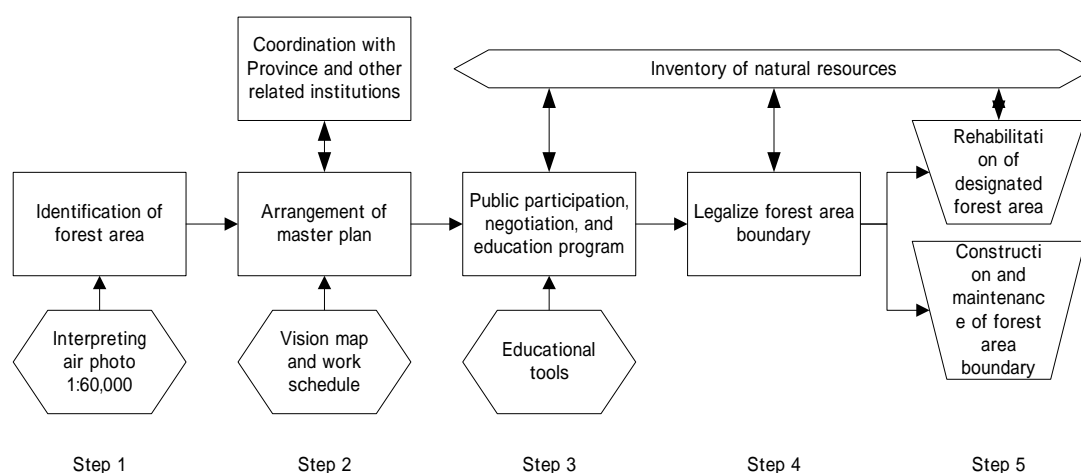


Figure 7.3.13 Five Steps for Designation of New Protected Forest

Table 7.3.17 Project Components for New Designation of Protected Forests

Component	Tasks	Province		Kabupatens, Kecamatan
		Forestry	Nature Conservation	
Forest identification	Satellite photo preparation	O		
	Field observation (sample)	O	O	O
	Differentiation standard model	O		
	Preparation of preliminary forest map	O		
On-site identification	Forest map improvement	O	O	O
	On-site marking of forest to be conserved		O	O
	Identification of human pressure on forest, stake holders		O	O
Forest conservation	Alternative resource development with consultation with stake-holders	O		O

7.3.6 Rehabilitation and Conservation of Natural Environment -Management of River Environment-

Management of River Environment (Program 3-9)

The objectives are: to recognize the location, area, and condition of mining, fishing and other economic activities in rivers, and to control and separate above activities safely so that impacts from activities would not conflict each other. This program aims to conserve multi-functional river environment

Leading institutions shall be Provincial Water Resource Management Office, in coordination with Kabupatens and Kecamatans, and Provincial and local BAPPEDA for water quality monitoring, and Kota social workers for compromising conflicting resource use. In local level, it is desirable to have various department share information on human activities, since major activities in river area varies from mining (sand and gravel), fishing, water intake for various purpose, and water use for daily housework.

Duration of the project shall be: Preparation of river map for three years, implementation of monitoring and management up to 2020, and longer. The project areas shall be all eight major tributaries in the Musi River Basin. However, it would be possible to select priority areas for urgent investigation and control. The priority areas must be chosen from; 1) areas under active sand/gravel mining activities, 2) areas under potential threat of chemical water pollution, and 3) areas suffering from significant sedimentation. Monitoring must also be conducted in the area where major water diversion is planned for irrigation, power generation, and other uses. The pre-project condition must be documented and utilized by planners and engineers to avoid substantial impact from the planned activities.

As far as the Team observed, priority areas may include sections of the rivers listed in **Table 7.3.18**.

Table 7.3.18 Example of River Sections under Significant Human Influences

River	Section, Town Nearby	Observed Human Activities/Influences
Komering	Martapura - Kayu Agung	Serious sedimentation and loss of water.
Lematang	Lubuk Sepang - Lahat - Niru	Sand and Gravel Mining, Urbanization, Diesel Power Plant (Lahat, Muara Enim), Pulp Factory, Oil Refinery (Niru), Oil Pipeline
Lematang (Air Enim)	Sugi Waras - Muara Enim	Gravel mining

Kota is recommended to prepare local land use regulation and enforce it. The regulation must include following guidelines. Project schedule is proposed in **Figure 7.3.14**.

- Recognition of the river area and locations and types of domestic, economic, and recreational activities. A map must be prepared that shows each structures outside

of the riverbank or outer-most linear structure like roads. Scale of the map may be 1:25,000 to 1:50,000.

- Prohibition of activities that will have conflict with existing use of river environment by land use ordinance, (e.g. wastewater release above intake for agriculture or domestic water.)
- Fish catching by bombs or toxic materials, and landfill in the river area must also be prohibited. Existing landfill is recommended for removal by the owner of the structure above.

Component	Tasks	2003	2004	2005	2006
River area identification	Preparation of preliminary river area map	■			
	On-site survey		■		
	River area map improvement		■	■	
	Identification of location with problems		■		
	Preparation of river area ordinance			■	
River area conservation	Informational meeting with communities			→	→
	Monitoring of construction activities				→
	Enforcement of order of recovery at problematic sites				→

Figure 7.3.14 Project Schedule for Management of River Environment

7.3.7 Rehabilitation and Conservation of Natural Environment -Conservation of Swamp and Mangrove Forests-

Conservation of Tidal Swamp Forests (Program 3-10)

The objectives of the program are; to recognize the location, area, and condition of remaining swamp forests; and to stop local farmers to clear those remaining forests. This program aims to conserve remaining tidal swamp forest, and regulate land clearance. Data of the remaining swamp forest may be obtained from the NOAA satellite images obtained daily for forest fire control. This project uses the data and takes a prevention measure against forest fire and forest clearance.

Leading institutions shall be Provincial Forestry office, in cooperation with National Nature Conservation office (Balai KSDA), Kabupatens, and Agriculture/Estate/Forestry Extension Offices in each Kecamatan. A few international institutions and NGOs have already conducted related studies in the area. It is recommended that these institutions are consulted at project design phase of this study and implementation. An NGO, Wetland International (WI), is working mainly for the greater Berbak-Sembilang peat swamp-mangrove area and has good experience in research on the natural resources. WI has project office in Palembang. Another institution, the Center for International Forestry Research (CIFOR), with the US Fish and Wildlife Service, has conducted a study on the cause of forest fires in Musi Banyuasin. The European Union has been

conducting the Forest Fire Prevention and Control Project (FFPCP). The project office is located in Palembang.

Duration of the project shall be preparation phase of three years, and implementation up to 2020. The project area shall be tidal swamp area in Banyuasin and OKI Kabupatens, excluding the transmigration project areas. Priority area may be chosen based on the criteria listed in **Table 7.3.19**.

Table 7.3.19 Priority Areas for Conservation of Tidal Swamp Forest

* Area in which serious forest clearance (forest fire) is recognized
* Area close to successful transmigration project. (Pressure for forest may not be serious, and residents may be cooperative in conservation effort)
* Area inside of designated conservation forests.
* Area that has good transportation access.

Forest identification may be conducted mainly in Palembang. After the preliminary forest map is prepared, major task will be transferred to field, and the leading agency will be Kabupatens or Kecamatans. Project duration from on-site inventory and forest conservation may take about 5 years. The action is the same with those presented in **Table 7.3.17**. Implementation plan is shown in **Figure 7.3.15**.

It is very important that local communities are involved in the earliest stage into the designation process. Identification of forested area, inventory of forest resources are good opportunities for government to work together with local residents. The draft of forest plan must be explained to communities possibly affected by the designation. The scientific base of the regulation must be well explained, and mitigating measures for impact on local economy must be sought both by the government and local community.

Since forest fire in swamp area causes long-standing haze, it is recommended that training of forest fire extinguisher be given during the community involvement.

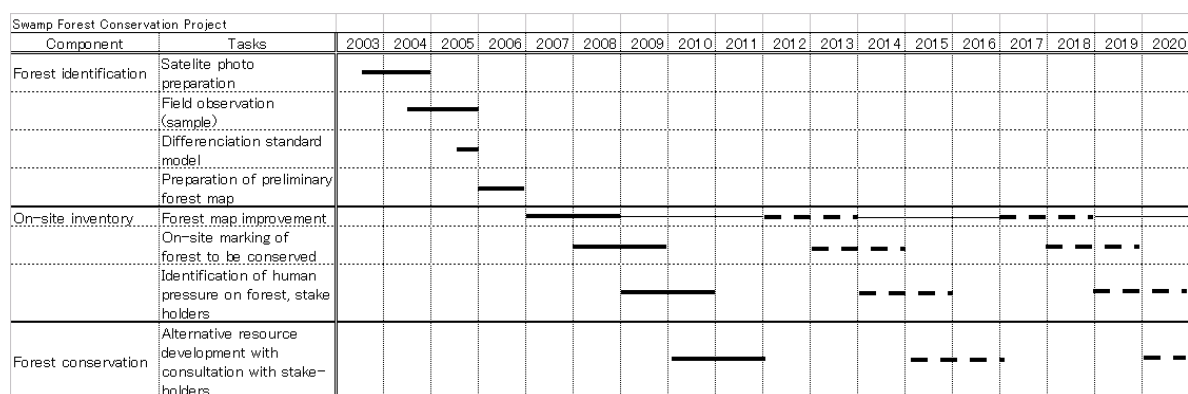


Figure 7.3.15 Project Schedule for Tidal Swamp Forest Conservation

Collection of Basic Data for Mangrove Area around the Proposed New Port (Program 3-11)

The objectives of the program are; to prepare for the detailed environmental impact assessment of the port; and to obtain data on natural environment to predict the impacts from construction and operation activities. The program is to acquire basic data of mangrove ecosystems around the proposed site for the Tanjung Api-Api Port.

Leading institutions shall be Provincial BAPPEDALDA, in cooperation with national and provincial office and research institutions for communication and transportation, fishery, nature conservation, trade and economics, and spatial planning. Duration of the project shall be research period of three years for good observation of seasonal dynamics of natural environment.

The project area shall be at least 5 km radius from the proposed site of the port. It should include Sunsang town for study on social environment. Precise study area must be determined in the preliminary phase of the research project, to include the possible area to be affected by the port. Project component shall be of the study that include natural and social environment. The scope of the study is described in **Table 7.3.20**.

Table 7.3.20 Scope of Study for Existing Condition at Tanjung Api Api

Natural environment	Water flow (marine, river, and seasonal flooding)	
	Sedimentation	Speed and amount of sedimentation, origin of the material,
	Aquatic animals	Marine, blackish, and swamp animals, especially the designated Endangered Species. Life cycles and habitats used at each phase of life cycle.
	Terrestrial animals	Mammals, birds, especially the designated Endangered Species. Life cycles and habitats used at each phase of life cycle.
	Vegetation	Non-affected vegetation, as well as vegetation that is affected by human activities, and vegetation that is in recovering phase after human destruction. Flora and spatial structure of vegetation.
Social environment	History of the area, and traditional rights to land and other resources	History of settlement, types of resources under traditional rights, traditional know-how of resource management.
	Present population, economic activities, and productivity/ income	
	Areas of cultural and religious value	

Conservation of Freshwater Swamp Area (Program 3-12)

This program aims at land use regulation in freshwater swamp. The objectives are to conserve the swamp function of retaining the floodwater in wet season, to avoid serious flooding in downstream, especially in Palembang City. The leading institutions shall be

Kabupaten BAPPEDA, in cooperation with Provincial BAPPEDA, and Kabupaten agriculture office (for rice farming).

Duration of the program shall be three years for preparation of local land use ordinance. Regular budget for monitoring and implementation of the ordinance shall be used. The project area shall be freshwater swamp area in 5 Kabupatens of OKI, Muara Enim, Musi Rawas, Musi Banyuasin, and Banyuasin. Project component shall be as follows: Each of the 5 Kabupatens is recommended to prepare local land use regulation and enforce it. Implementation schedule is proposed in **Figure 7.3.16**. The regulation must include the following guidelines.

- Recognition of the freshwater swamp area. A map must be prepared based on the soil type.
- Prohibition of landfill in the swamp area.
- Limitation of land use type in the swamp area. The swamp area must be used either as rice field, fishpond, or natural open space.
- Conservation of remaining natural environment. In the area that escaped agricultural development, it is recommended to conserve the natural environment. In addition, where rice farming is stopped, it is recommended to designate the area as rehabilitation area for nature.

Component	Tasks	2003	2004	2005	2006
Swamp area identification	Preparation of preliminary swamp area map	■			
	On-site survey		■		
	Swamp area map improvement		■	■	
	Identification of location with problems		■	■	
	Preparation of swamp area ordinance			■	
Swamp area conservation	Informational meeting with communities			⋯→	→
	Monitoring of construction activities				→
	Enforcement of order of recovery at problematic sites				→

Figure 7.3.16 Project Schedule for Freshwater Swamp Conservation

7.3.8 Selection of Priority Programs

Proposed programs are evaluated based on four points (**Table 7.3.21**). Evaluation is made in three numerical points, 5, 3, and 1, and the points are summed up. A program that gains larger points is understood to have higher priority. As a result, following projects are chosen for higher priority.

- Program 3-1 Application of Agroforestry on Land with Major Constraints

- Program 3-3 Strengthening of Agriculture/ Estate/ Forestry Extension
- Program 3-4 Reforestation of Production Forest and Forest Estate
- Program 3-6 Inner- and Inter-Basin Coordination
- Program 3-7 Rehabilitation of Existing Protected Forests

Table 7.3.21 Evaluation of Priorities for Each Proposed Programs

Programs of Watershed Management	Prerequisite to Other Programs	Degree of Seriousness	Requirement of Early Start	Cost Scale	Total	Priority Order
Soil erosion prevention						
3-1: Application of agroforestry on land with major constraints	5	5	5	3	18	1
3-2: Land use regulation on land with major constraints	5	5	5	1	16	6
3-3: Strengthening of agriculture/estate/ forestry extension	5	5	5	3	18	1
3-4: Reforestation of production forest/Forest estate	5	5	5	3	18	1
3-5: Enforcement of prevention of illegal logging	3	5	3	5	16	6
3-6: Inner- and inter-basin coordination	5	3	5	5	18	1
Biodiversity rehabilitation and conservation						
3-7: Rehabilitation of existing protected forests	5	5	5	3	18	1
3-8: Increase designated protected forests	3	5	3	3	14	8
3-9: Management of river environment	1	1	1	5	8	11
3-10: Conservation of tidal swamp forests	1	3	3	3	10	10
3-11: Collection of basic data for mangrove area around the proposed new port	5	3	3	1	12	9
3-12: Conservation of freshwater swamp area	1	3	1	3	8	11

Note) Score 5 (High Priority); 3 (Middle Priority); 1 (Low Priority)
Cost Scale 5 (Kabupaten and Provincial Budget), 3 (National Budget), 1 (International Budget)

7.4 Component 4: Urban Water Environment Improvement

7.4.1 Identification of Programs and Objectives

Urban areas scattered in the Musi River Basin have various living environment problems. Especially, deterioration of water environment is one of the major issues for the comprehensive water management of the Musi River Basin. This problem is distinguished and serious in Palembang whose population is approximately 1.5 million and shares nearly one fourth of the basin's population of 6.3 million. It is reported that the number of persons treated for waterborne or water-related diseases in Palembang Municipality amounted to 102,343 (1986). Cause and effect of the urban water environment problem is summarized as **Figure 7.4.1**.

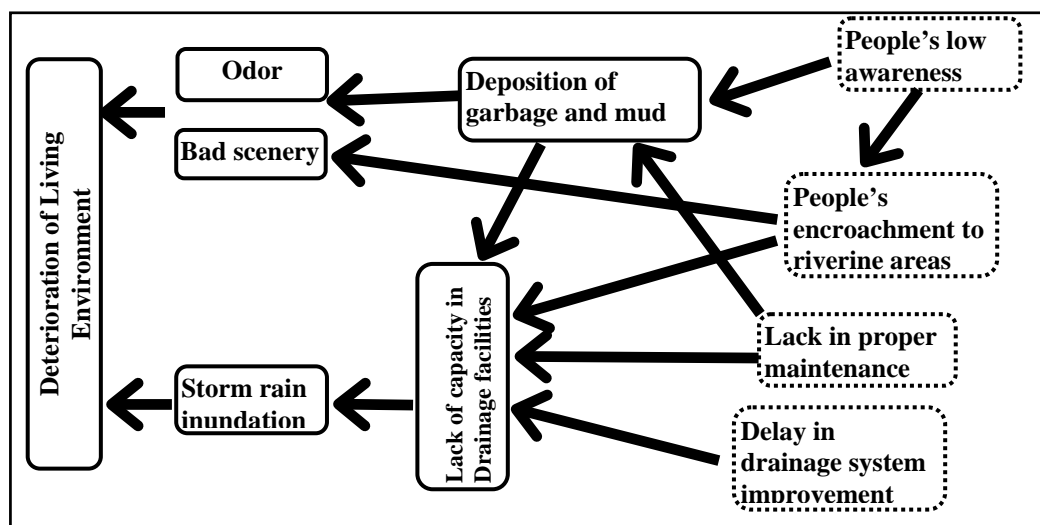


Figure 7.4.1 Cause and Effect of the Urban Water Environment Problem

The objective of the Urban Water Environment Improvement is to solve these urban water environmental problems in Palembang as a pilot city with the following programs.

- Community Drainage Management Program
- River Areas Conservation Program
- Trunk Drainage Channels Rehabilitation Program
- Drainage System Improvement Program

7.4.2 Community Drainage Management

For the improvement of urban environment, involvement of the community is indispensable. Though improvement or new construction of infrastructure will be needed, improved environment can be achieved with the people's willingness. **Community Drainage Management Program (Program 4-1)** is proposed as the start of the urban environment improvement.

Objective and Leading Agency

The objective of the program is to realize better water environment in the community level through the following activities. Leading institution is Dinas Kimpraswil of Palembang Municipality. Relevant community organizations are NGOs, schools, etc.

Activities

- (1) Choose one drainage area: Chosen area is recommended to have strong, existing community organization.
- (2) Preparation meeting with key persons in community
- (3) 1st meeting with the community: objectives, free discussion
- (4) 2nd meeting: trip to good example.
- (5) 3rd meeting: PCM list up project components, decide on future vision. Project components may include following actions.
 - Storage and gathering of house garbage for prevention of odor
 - Removal of plants and garbage, and dredging of the bottom mud in watercourse (tertiary drainage channel and tertiary to the house drainage level) every 4 months, for smoother water flow and to control the odor. Collected garbage and mud should be treated appropriately for dumping
 - Setting a public sign for prevention of garbage dumping to appeal the public about the community's effort
 - Holding inter-neighborhood meeting to understand different needs and perception about one drainage (inland, riverside)
 - Hygienic and public moral education to children at schools.
- (6) Commencement of the project
- (7) Evaluation meetings in every 2 months.
- (8) Final meeting for the model project
- (9) Summarize and share the obtained know-how for future phase. Formulate project terms for the following standard implementation.

Standard Implementation

Follow the project procedure learned from the model project, two or three projects in one two-year term are recommended to conduct. By the year 2020, eight implementations, 19 drainage systems, may be covered by the improvement project.

In the standard implementation, it is important to include a visit to the community that already experienced the project, so that participants in the new project can directly communicate with the people who already experienced the difficulties and rewards of the improvement work.

Implementation Schedule and Cost Estimate

Implementation schedule of Community Drainage Management Program is shown in **Figure 7.4.2**. Implementation cost has been estimated at Rp. 440 million (US\$0.049 million).

Title	1st Year				2nd Year				3rd Year				4th Year				5th Year			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Community Drainage Management																				
Model project	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Monitoring of past project														■	■	■	■	■	■	■
Standard Implementation																				➔

Figure 7.4.2 Implementation Schedule of Community Drainage Management Program

7.4.3 Riverine Areas Conservation

Boundary of river area (right-of-way) and conservation of the area are declared in Ministerial Regulation of Ministry of Public Works No.63/PRT/1993. The boundary of the river area is not clear in everywhere. River areas in the urban cities are sometimes not controlled and the environmental condition is worst with illegally built houses and dumping of garbage, etc. Conservation of river area is important for urban environment improvement. **Riverine Areas Conservation Program (Program 4-2)** has been proposed as follows:

Objective and Leading Agencies

The objective of the program is to conserve the river function of floodwater retention in wet season and to allow smooth flow of the water to avoid inundation in the city. Palembang Municipality BAPPEDA, in cooperation with Provincial BAPPEDA, and the Municipality social workers shall be the leading institutions.

Activities

Three years for preparation of local land use ordinance, and regular budget for monitoring and implementation of the ordinance afterward shall be considered. Palembang Municipality is recommended to prepare local land use regulation and to enforce it. The regulation must include the following guidelines.

- Recognition of the river area. A map shall be prepared that shows each structures outside of the riverbank or outer-most linear structure like roads. Scale of the map shall be 1:2,500 to 1:5,000.

- Prohibition of landfill in the river area shall be declared in the land use ordinance. Existing landfill is recommended for removal by the owner of the structure.
- Limitation of architectural structure type in the river area shall be declared. The houses in the river area must be built on pillars tall enough to allow free flow of water in the wet season. Proposed team organization is shown in **Table 7.4.1**.

Table 7.4.1 Proposed Team Organization

Item	Detail Item	Municipality			Province
		BAPPEDA		Social Workers	BAPPEDA
		Map Operators	City Planners		
River area identification	Preparation of preliminary river area map	5			
	On-site survey	1	4	1	
	River area map improvement	2			
	Identification of location with problems		4	1	
	Preparation of river area ordinance		2		1
River area conservation	Information meeting with communities		4	4	1
	Monitoring of construction activities		2	1	
	Enforcement of order of recovery at problematic sites		2	1	

Guiding Principles

Houses in the river area of the Musi River have been used as affordable housing in Palembang City. Although these houses may interrupt the flow of the water in the river, it will be socially difficult to remove the houses in a short time period. The City government is recommended to implement land use regulation on the river area to control the style of construction work to minimize impact on the river flow. The experiment of Palembang City shall be applied to other large cities and towns on major tributaries, such as Muararupit, Muarabeliti, Lubuklinggau, Lahat, and Baturaja.

Target area

Target area is the area along the Musi, Ogan, and Komering rivers in Palembang City. The total length of the rivers within the city limit is approximately 22.5 km. According to the Land Use Regulation of Palembang City, the river area is designated as the area within 15 meters from the top of the riverbank. Therefore, the target area is estimated to be 0.675 km² (or 67.5 ha). The house density in the above area is assumed to be 13,333 house/km² (or 133 house/ha). Thus, the number of houses within the target area is estimated to be 9,000 houses (households).

Implementation Schedule and Cost Estimates

Implementation schedule of riverine areas conservation program is shown in **Figure 7.4.3**. Implementation cost has been estimated at Rp. 100 million (US\$0.011 million).

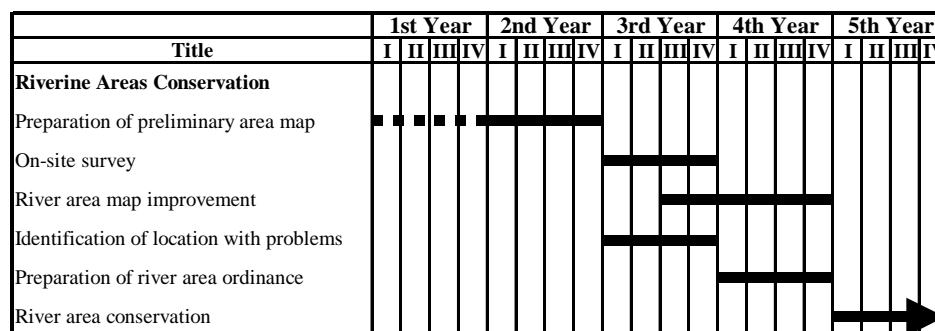


Figure 7.4.3 Implementation Schedule of Riverine Areas Conservation Program

7.4.4 Trunk Drainage Channels Rehabilitation

Maintenance of trunk drainage channels, primary and secondary channels, is under the responsibility of Dinas Kimpraswil of Kota Palembang. There are a total of 19 drainage systems in Palembang Municipality. Though the trunk channels have been improved in major drainage basins in the City center, deterioration of the facilities and deposition of mud are identified in almost all channels. Due to the lack of budget, proper maintenance for the existing drainage channels have not been conducted. Strengthening of the capability of the regular maintenance of the structures shall be a prerequisite to the new construction of the facilities. **Trunk Drainage Channels Rehabilitation Program (Program 4-3)** has thus been proposed.

Objective and Leading Agency

The objective is to establish the system for the drainage system rehabilitation. Drainage system improvement proposed in the **Program 4-4** can be implemented when such rehabilitation system is established and start functioning. Dinas Kimpraswil of Kota Palembang is the leading agency for this program.

Activities

Rehabilitation program consists of excavation of garbage and mud and rehabilitation of trunk drainage channel (primary and secondary drainage channel). This program improves capacity of drainage channels and sanitary condition, and scenery in the city.

Implementation Schedule and Cost Estimates

Implementation schedule is shown in **Figure 7.4.4**. Drainage system of central commercial area is carried out at beginning stage as model project. Implementation cost has been estimated at Rp. 33,495 million (US\$3.707 million).

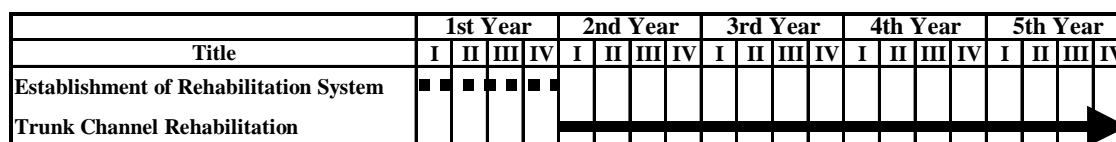


Figure 7.4.4 Implementation Schedule of Trunk Drainage Channel Rehabilitation Program

7.4.5 Drainage System Improvement Program

One of the water environment problems in urban area is storm water inundation. The present study identified that Palembang has this inundation problem. The detailed study has been conducted to minimize storm water inundation in Palembang.

Capacity of Existing Drainage System

The drainage system in Palembang City is divided into 19 drainage systems. Each system consists of structures, e.g. detention ponds, primary channels, secondary channels, and tertiary channels. The present flow capacities of the 19 drainage systems are studied.

As the boundary condition, high tide water level of the Musi River has been determined as follows: In the rainy season, the high water level of the Musi River is +1.8 m above mean sea level, and the mean water level is +1.05 m. Duration of higher water level than mean water level is about 12 hours. The average water level during the 12 hours was estimated at +1.6m above mean sea level, and this value was used for the downstream boundary water level.

The flow capacity of each drainage system was checked by non-uniform flow calculation. In this Study, the Team conducted longitudinal and cross-sectional survey for the channels except those of drainage system 1, 2, 3, 12, 13, 18 and 19. The result of the survey was used for the calculation. For the drainage systems where the survey was not conducted, longitudinal profile was obtained from the final report of ADB LOAN 1383 INO, and typical cross sections were applied.

Improvement Plan for the 19 Drainage Systems

The design scale for the drainage improvement of Palembang City has been determined at 15-years referring to the criteria for selection of the appropriate return period for drainage planning in Flood Control Manual (Volume 1, Project No. WSTCF 091/011). Design hydrograph was determined for each drainage system based on the future land use in the target year 2020 (based on the development plan of the year 2009). Shortage capacities of 19 drainage systems are estimated as excess volume of the design hydrograph against the present channel capacity. The excess volumes of each drainage system and applicable measures are tabulated in **Table 7.4.2**.

Capacity of drainage systems of 1, 2, 3, 5, 6, 7, 8, 11, 12, 14, 18 and 19 is not enough for the design hydrograph. In these drainage systems, however, 5, 7 and 14 drainage systems are not so serious. Many swamps are located in the drainage systems in the outer side of the City, namely, 1, 2, 3, 11, 12, 13, 18 and 19. These swamps can be expected as detention ponds, when they are conserved by existing city regulation. (In article 10 of Palembang City law as Swamp conservation, swamp reclamation can only be done for 50% of total development area in case the development area is 1,000 m² or more. Type of buildings that can be built on swamp area is kinds of stilted type buildings.)

Table 7.4.2 Excess Volume and Applicable Measures

Drainage System	Excess volume (m³)	Applicable Measures
Gandus	125,000	Use swamp as detention pond
Gasing	96,000	Use swamp as detention pond
Lambidaro	38,000	Use swamp as detention pond
Boang	0	
Sekanak	2,000	Drainage channel improvement
Bendung	100,000	Drainage channel improvement
Lawang Kidul	3,000	Drainage channel improvement
Buah	104,000	Drainage channel improvement
Juaro	0	
Batang	0	
Selincih	69,000	Use swamp as detention pond
Borang	56,000	Use swamp as detention pond
SP. Nyiur	0	
Sriguna	2,000	Drainage channel improvement
Aur	0	
Kedukan	0	
Jaka Baring	0	
Kertapati	183,000	Use swamp as detention pond
Keramasan	474,000	Use swamp as detention pond

According to the land use plan for 2009, drainage systems 1, 2 and 19 are agriculture and swamp area. Drainage system 3 is swamp-housing area. Drainage system 11 and 13 are industry and agriculture area. Drainage system 12 is housing, agriculture and swamp area. Drainage system 18 is industry, commerce and forest area. According to land use study, land use on 2020 is almost same as the plan on 2009. Therefore, the swamps can be used as measures of the drainage systems of 1, 2, 3, 11, 12, 13, 18 and 19 until 2020.

In drainage system 17, there are two existing ponds with a total area of 4 ha, and a 40 ha pond inclusive of areas and drainage systems are under construction for the sports center area. Therefore, no problem of drainage exists in drainage system 17. No serious problems can be found in drainage system 4, 9, 10, 15 and 16 as the systems' trunk channel capacities are still sufficient.

Conversely, drainage system 6 and 8 suffer serious problems because of the insufficiency of the systems' trunk channel capacities. Drainage system 6 area is of the commercial and residence area. There is no more space to widen the channel, and no large areas for detention pond are available. Dredging the channel bed and/or heightening the channel wall in low land area are considered to be the applicable way.

Many residences and a fertilizer factory are located in drainage system 8. There is no more space to widen the channel, but some areas to function as detention pond was identified. Dredging the channel bed and heightening the channel wall in low land area is also required. In consideration of the above, drainage system 6 and 8 are selected as the proposed project areas for further study.

Improvement Plan for Drainage System 6

Present channel alignment has not been changed in the proposed plan. Design discharge distribution of Bendung channel for the design scale of 15-year return period is shown in Figure 7.4.5.

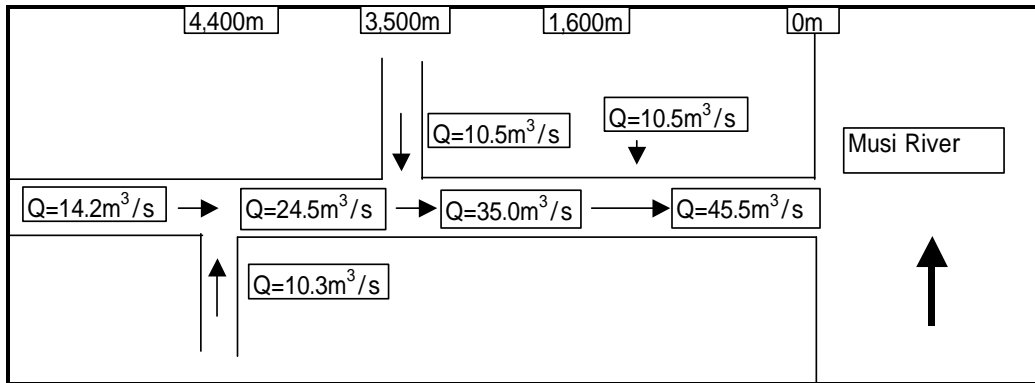


Figure 7.4.5 Design Discharge Distribution of Bendung Channel

Alternatives for channel improvement have been studied and Alternative-2 that proposes excavation of channel bed by 1 m in average and smoothing of the longitudinal profile has been selected. Stone masonry protection works are employed to protect the existing revetment. Proposed profile for Alternative-2 presented in Figure 7.4.6.

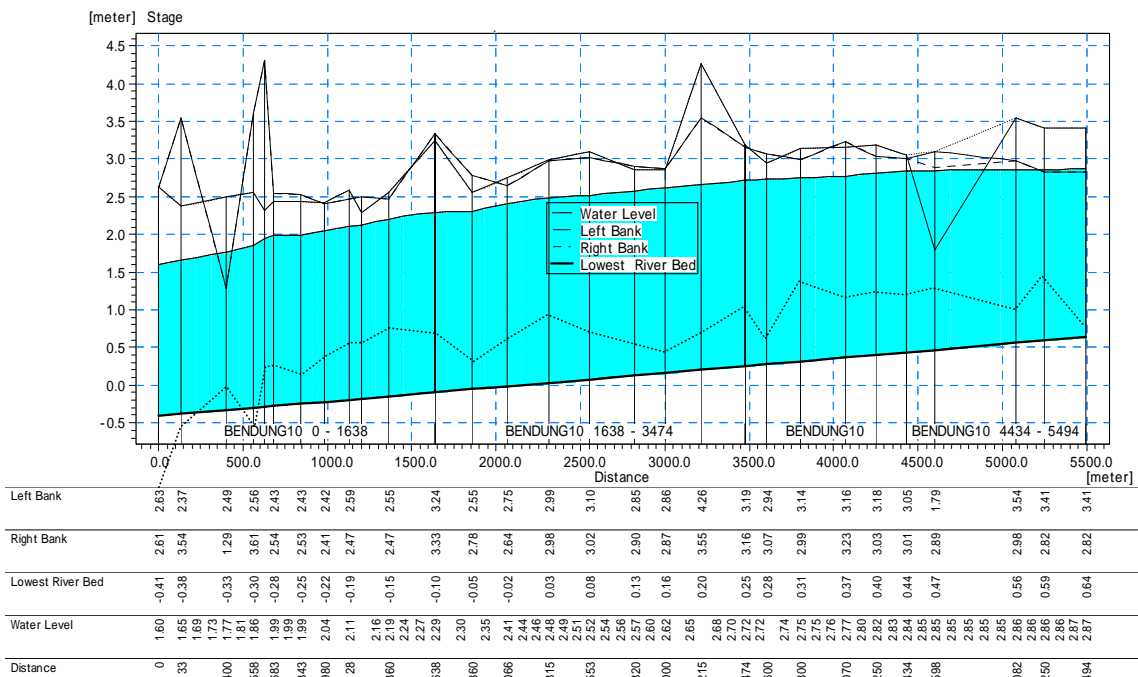


Figure 7.4.6 Proposed Profile for Bendung Channel Improvement

An average depth of 1.0 m and the total length of 8,990 m including branch channel give the total dredging volume at 110,000m³. Stone masonry works is about 32,400 m³. Alternative-2 has finally been selected for the proposed plan.

Improvement Plan for Drainage System 8

Present channel alignment has not been changed in the proposed plan. Design discharge distribution of Buah Channel for the design scale of 15-year return period is shown in Figure 7.4.7.

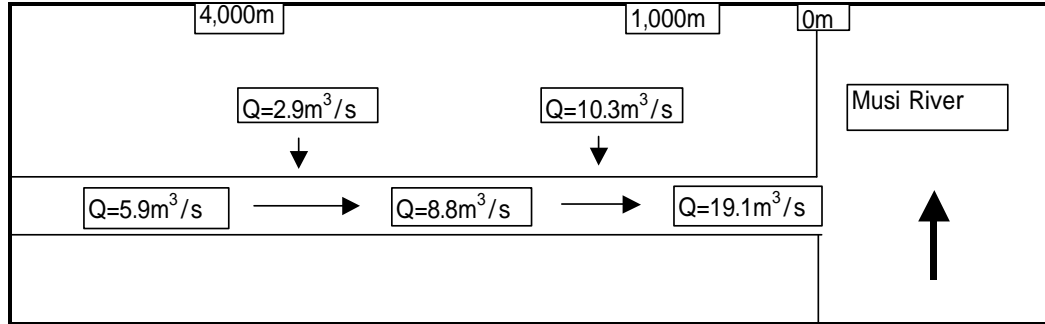


Figure 7.4.7 Design Discharge Distribution of Buah Channel

Alternative improvement plans have been studied and Alternative-3 has been selected. In this alternative, channel bed excavation at the mouth of the channel, excavation of channel bed by 0.5 m in average for smoothing of the longitudinal profile, and channel wall heightening at critical location were proposed. Work volume is as follows:

- For 0.5 m depth of dredging and total length reaches of 6,400m from river mouth toward upstream, the dredging volume is turned out to be 25,000m³.
- Stone masonry protection works are employed to protect the existing revetment. The works volume is about 6,800m³.
- 0.5m heightening: 1,400m length, 420m³ concrete volume

Proposed profile is shown in Figure 7.4.8.

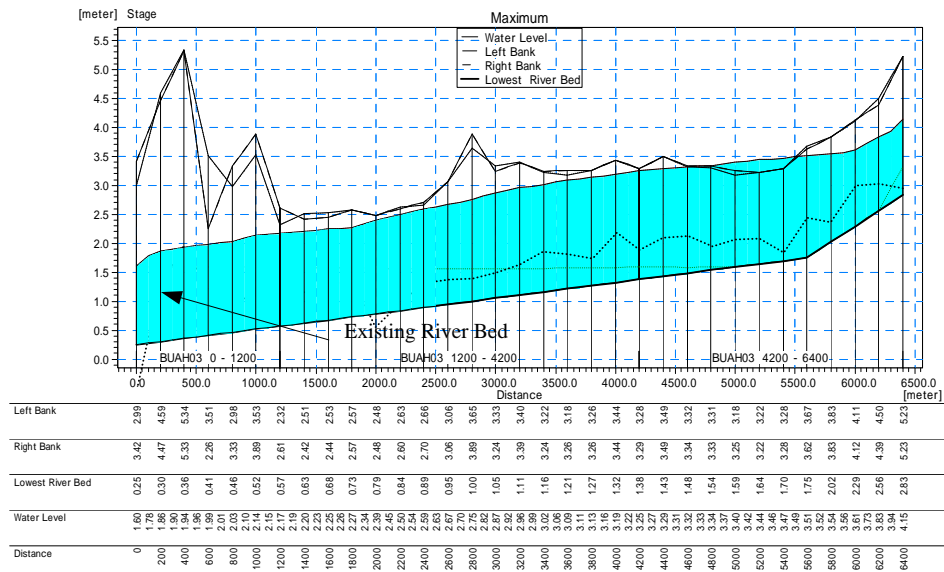


Figure 7.4.8 Proposed Profile for Buah Channel Improvement

Drainage System Improvement Program (Program 4-4)

The Study Team examined the present capacity, degree of inundation damage, and urgency of improvement of existing 19 drainage systems in Palembang Municipality. Two drainage systems, namely, Bendung Drainage System (System No.6) and the Buah Drainage System (System No.8), have finally been selected for early implementation.

Drainage improvement of Bendung Drainage system is as follows: The total stretch of the primary channels in the Bendung Drainage System is approximately 9 km. Alignment of the present channels has not been changed in the proposed plan. Longitudinal plan proposes average 1 m deep excavation and smoothing of the riverbed. Proposed cross section of the channel maintains the existing concrete wall and excavation/dredging is proposed in the riverbed. Stone masonry protection works are proposed to protect the existing concrete revetment

Drainage improvement of Buah Drainage System is as follows: The total stretch of the primary channel is about 6.4 km. Alignment of the present channels has not been changed in the proposed plan. Longitudinal plan proposes average 0.5 m riverbed excavation and smoothing. In the proposed section, concrete revetment is maintained as present condition and stone masonry protection works are proposed to protect it from sliding after the excavation.

Implementation Schedule

Implementation schedule of drainage system improvement program is shown in **Figure 7.4.9**. Implementation cost has been estimated at Rp. 31,785 million (US\$3.518 million).

Title	1st Year				2nd Year				3rd Year				4th Year				5th Year				
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
Drainage System Improvement																					
Project proposal	■	■	■	■																	
Basic design					■																
Detailed design									■												
Implementation																					

Figure 7.4.9 Implementation Schedule of Drainage System Improvement Program

7.4.6 Selection of Priority Programs

As a result of study on the component of urban water environment improvement in the previous chapter, the following four programs were developed:

- Community drainage management program
- Riverine area conservation program
- Trunk drainage channel rehabilitation program

- Drainage system improvement program

Discussions were made to give priority on the above programs for their implementation as presented below.

Community drainage management program is high degree of seriousness and low cost scale. This program needs early start also. Riverine area conservation program shall be conducted with the continuous and sustainable manner by Palembang Municipality. Trunk drainage channel rehabilitation program shall be conducted with the continuous and sustainable manner by Palembang Municipality. This program is high degree of seriousness and needs early start. Drainage system improvement program shall be conducted with the continuous and sustainable manner by Palembang Municipality. Thus the priority of riverine area conservation program and drainage system improvement program in the comprehensive water management is judged low.

Priority of urban water environment (Component 4 of the Master Plan for Musi River Basin Comprehensive Water Management) is shown in **Table 7.4.3**.

Table 7.4.3 Priority of Urban Water Environment Improvement

	Programs of Urban Water Environment Improvement	Prerequisite to Other Programs	Degree of Seriousness	Requirement of Early Start	Cost Scale	Total	Priority Order
1	Community Drainage Management (Program 4-1)	3	5	5	5	18	1
2	Riverine Areas Conservation (Program 4-2)	1	3	3	5	12	3
3	Trunk Drainage Channels Rehabilitation (Program 4-3)	3	5	5	3	16	2
4	Drainage System Improvement (Program 4-4)	3	3	3	3	12	3

Note) Score 5 (High Priority); 3 (Middle Priority); 1 (Low Priority)

Thus two programs, community drainage management program (Program 4-1) and trunk drainage channels rehabilitation program (Program 4-3), were selected as priority projects of urban water environment improvement (Component 4).