CHAPTER 9 PLANNING FOR WATERSHED CONSERVATION AND MANAGEMENT

9.1 Lessons Learned and Need for Water Conservation

9.1.1 Lessons Learned and Key Issues for formulation of Watershed Conservation

As mentioned earlier in Section 2.6, the Government performed a re-greening program during the 1960s. Afterwards UNDP/FAO conducted a soil erosion control project in the 1970s in the Solo River basin containing the Wonogiri dam watershed area. Then, IBRD performed a watershed management project for the Wonogiri dam watershed area on a large scale. Past efforts for the watershed conservation in the Wonogiri dam watershed area were under the Upper Solo (Wonogiri) Watershed Protection Project financed by IBRD and implemented by Ministry of Forestry from 1988/89 to 1994/95. After the project, activities for the conservation of watershed were continued in a limited scale by utilizing district, provincial and national budgets. In 2003, GERHAN was launched for the scheduled period of 2003 to 2007 and conservation activities in the watershed area were restored to a more substantial level. The lessons learned from the past watershed conservation efforts in the watershed area are described in Table 9.1.1.

In the formulation of the conservation measures for the Wonogiri dam watershed area, key issues to be duly addressed were identified through the study of the present conditions/problems & causes and lessons learned and are enumerated as follows:

(1) Technical Issues

- Comprehensive development of a basin so as to make productive use of all its natural resources of soil, water and vegetation, and also protect them is termed “watershed management” and could be achieved through integrated and collaborated activities for watershed conservation.
- Emphasis on agricultural approaches should duly be considered as agricultural lands occupy the majority of the watershed area and farmers accounting for almost all target groups related to conservation measures. Most causes of erosion are attributed to agricultural activities and most erosion control measures are also closely related with them.
- Introduction of tree crops provides an effective measure against soil erosion. However, the types of agro-forestry should be determined based on comprehensive study on natural and socio-economic conditions as there will be certain competition between forestry and agricultural uses of the land.
- Conservation techniques to be introduced should be readily accepted by the farmers (practitioners)
- In many cases anticipated results will not be produced without sufficient understanding and agreement of practitioners, the farmers/farmer groups on the meanings, benefits and other details of conservation measures.
- It is prerequisite for a scrupulous technical conservation that each watershed project should be approached taking into consideration characteristics of soil erosion, socio rural differences among farmers, customs, rural organizations and so forth in the watersheds.

(2) Management Issues

- There have been few successful watershed conservation projects performed under a full top-down management and/or use of inflexible prescriptions poorly adapted to local conditions. The projects need to be formulated to reflect the real needs of farmers (practitioners) and to spread the small project expenditures among villages and communities in the project area.
- Since the area of the watershed conservation projects for the river basins is generally huge and cover many kecamatans and the communities (villages), water conservation projects based on river basins without institutional coordination often encounter administrative problems concerning the understanding and agreement among farmers (practitioners) for implementation of the projects. It is very important that the watershed conservation projects should be carried out by community-based development and not by the river basin-based development.
- Grant aid in the terrace rehabilitation projects has resulted in a detrimental change in social behavior related to self-reliant activities. It is, however, necessary for the proper implementation and management of the watershed projects that appropriate incentives should be provided to the farmers (farmers groups) as real practitioners.
- Although initially implemented, monitoring of the performances of the programs was seldom practiced in the past. Problems and constraints encountered in the project implementation and management were not identified and not reflected in any improvement of the effective project implementation, sustainable operation and maintenance of the watershed management.

(3) Socio-institutional Issues

- The link between poverty, aging of farmers, poor management of dry farm land and farm land being left unattended due to farmers seeking off-farm income in the cities, should be addressed as much as possible. Therefore, packages of conservation measures and improved agricultural practices must provide adequate, immediate and long-term financial gains to farmers to ensure positive participation by dry land farmers.
- In order to smoothly implement the watershed conservation projects and expedite their sustainable effects, the strong extension works, which are performed by PPL (Field forestry extension staff) and PKL (Field forestry extension worker), are very important.
- The decentralization programs have weakened the effective technical transfer with agriculture and watershed conservation that had been run through the central government to the local governments (province, Kabupaten, Kecamatan and villages), and improvement in institutional technical transfer is required. Moreover, communication among the related authorities concerned in charge of watershed conservation activities, is weak and improvement in this area is one of the most important factors for the smooth implementation of the projects.

9.1.2 Needs of Local Communities

Village assessment based on the participatory rural appraisal (PRA) was implemented in the selected 24 villages during June - September 2005. In succession, village workshops were carried out for formulation of village action plan for soil conservation in November and December 2005. The needs analysis as mentioned below was made through the village assessments and village workshops. Details are described in the Supporting Report

II Annex No. 10.

(1) Need for Soil Conservation

The results of needs analyses of the village action plans are summarized below:

Table 9.1.2 Issues Indicated by More Than 30% of Surveyed Villages

Category	Content	No. of Villages	Remarks
Soil Erosion	Shortage of Erosion Control Structure/Many locations of Erosion	22	
Less Forest	Less number of trees in the slope area	11	
	Less number of trees in the state forest area	9	
	Decreasing of springs/groundwater	13	Caused by decreasing in number of trees
Institutional Issues	Low capacity of existing groups	13	
	Lack of coordination with government agencies	8	
	Less attendance of field officers	9	
Economic Issues	Low income of agriculture	12	
	Insufficient capital of new business	9	

Source: Result of JICA Village Survey made during May – December 2005
Note: Total number of survey village is 24.

The above table indicates that the high priority issues of people are soil erosion, less number of tress, less coordination with governmental organizations, low income of agriculture. According to the discussion in the workshops, people understood that soil degradation has caused low crop yields as well as decrease of trees and caused negative impacts on water resources. The conclusion, therefore, is that villages need soil conservation and re-planting.

(2) Priority of Countermeasures for Soil Erosion

According to the analyses of village action plans, most of villages favored a higher priority on civil works such as small gully plugs and improvement of drainage channels for soil conservation. As next priority, trees planting and terraces rehabilitation were selected. People noted that civil works need more government assistance, as the more budget is required. Therefore, there is some difference of opinion in the priority of countermeasures for soil erosion.

(3) Link with Economic Development

Economic issues such as low income of agriculture and insufficient capital for new business are high priority. Seasonal migration to large cities is becoming an indispensable family activity to supplement the income. Farmers have become reluctant to improve soil condition such as terracing through labor intensive works. Moreover, low economic conditions cause illegal logging in the state forest. The survey team understands that one of the most important aspects in the soil conservation program is economic uplift.

(4) People's Understanding of Soil Erosions

The result of PRA indicated that people understand the location and degree of soil erosion in the village as summarized below:

Table 9.1.3 Nos. of Erosion Location in Surveyed Villages

	Rill (Sheet) Erosion	Gully Erosion	Landslides	Riverbank Erosion	Total
Total	213	112	52	155	532
Average	8.9	4.7	2.2	6.5	22.2

Source: Result of JICA Village Survey made during May – December 2005

All the surveyed villages prepared their own soil erosion maps and proposed countermeasures. As a result, the people identified 532 erosion locations in total. On the other hand, there is no correlation between the numbers of erosion locations specified by the village and annual sedimentation yield estimated by the JICA Study Team. It indicates that the people could not compare the erosion damage with other villages and assess the overall soil erosion damage.

(5) People's View of Soil Erosion Program

No village identified that the purpose of soil erosion program is to maintain the storage capacity of the Wonogiri dam. They believe that the program is aimed at maintaining the fertility of their agriculture land. On the other hand, the concern of the people about the dam is very low, since people receive little benefit from the dam.

(6) State Forest (Hutan Negara) vs People's Forests (Hutan Rakyat)

Out of the 24 village surveyed, 13 villages were allied with the State forest. 11 of them assessed that management of the state forest as not so good. Villages said that the people's forests are well maintained, while illegal logging and cultivation are common in the state forest. Illegal activities caused soil erosion, appearance of wild monkeys and pigs, and decreased of water resources.

(7) Share of the Responsibility

People expressed that they are ready to share the responsibility of the soil conservation program. A summary of assistance required is as follows:

Table 9.1.4 Summary of Assistance Required from Government

Item	Labor	Materials	Others
Terrace rehabilitation	50% of labor wage should be provided.	Construction materials should be provided, if not available in the village.	-
Structure Rehabilitation or construction	75% of labor wage should be provided.	Construction materials should be provided.	-
Tree planting	0-50% of labor wage should be provided.	Seeds of trees should be provided.	Seeds of inter cropping should be supported.

Source: Result of JICA Village Workshop made in December 2005

They noted that they need the technical and financial assistance of the governments for civil works, while terrace rehabilitation and tree plantings can be carried out by the people with minimum assistance. In addition, people expressed that they could carry out the socialization program for each rural community, establishment of the implementation committee, and preparation of the detailed proposal.

(8) Activities of Existing Organizations

People feel that seasonal migration weakens existing organizations, since 30-60% of households have family members who make migrate. Local NGOs also reported that social solidarity, in working together in self-reliant activities for the village, has been upset by the grant aid provided by the past projects.

(9) Activities of Supporting Services

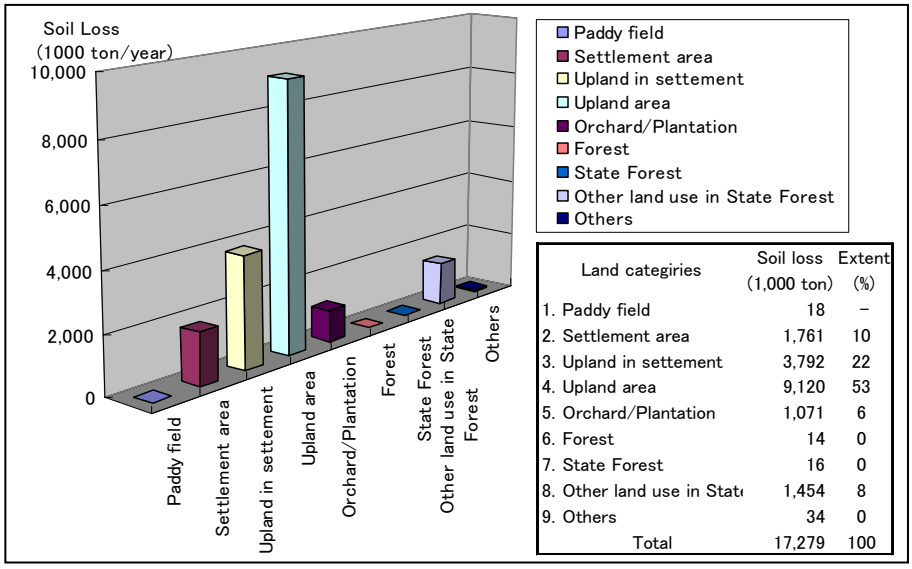
People feel that forest or agriculture extension staff as well as local NGOs are relatively remote, since the majority of extension staff and NGOs only come to the community when the project is implemented. On the other hand, extension staff noted that they are very busy on project management due to limited number of staff.

9.2 Basic Strategies for Watershed Conservation

9.2.1 Detailed Soil Erosion Sources and Subject Areas for Watershed Conservation

(1) Annual Average Soil Loss by Land Use

As explained in Chapter 4, the main soil erosion sources and soil loss from the Wonogiri dam watershed are the land surface, producing about 93% of the total sediment yield from the watershed. The total annual average soil loss from the watershed mainly consists of soil loss from i) upland fields, ii) settlement areas under upland field condition, iii) settlement areas, and iv) the state forest. These four main soil erosion sources cover over 90% of the total soil loss from the Wonogiri dam watershed as shown in Figure 9.2.1 below.



Land categiries	Soil loss (1,000 ton)	Extent (%)
1. Paddy field	18	–
2. Settlement area	1,761	10
3. Upland in settement	3,792	22
4. Upland area	9,120	53
5. Orchard/Plantation	1,071	6
6. Forest	14	0
7. State Forest	16	0
8. Other land use in Stat	1,454	8
9. Others	34	0
Total	17,279	100

Source: JICA Study Team

Figure 9.2.1 Annual Average Soil Loss by Land Use in Wonogiri Catchment

The state forest area was excluded from the target areas for the conservation of watershed because the state forest is under the control and management of the State Forestry Corporation and the reforestation programs are on-going.

(2) Subject Areas for Watershed Conservation

It may be concluded from the above results that upland fields, settlement area under upland field condition and settlement areas should be the main soil loss sources in the Wonogiri dam watershed. The subject areas for the Wonogiri dam watershed conservation under the present Study are shown below:

Table 9.2.1 Subject Areas of Watershed Conservation under the Present Study

Subject Area	Remarks
Uplands	Occupy about 1/3 of the watershed area from low lying area to steep sloping area
Uplands in Settlement areas	Mainly used for annual crop production with limited vegetative cover of perennial crops or trees
Settlement areas	Housing yard and home garden covered with perennial crops/trees
Non-subject Area	**Remarks**
Paddy fields	Best sustainable land use in terms of soil conservation
Orchard/plantation under tree/tree crop	People's forest/orchard/plantation; limited in extent
State forest	State forestlands are owned by the Estate Forestry Corporation and their reforestation was programmed.
Others	Limited in extent

Source: JICA Study Team

The area extents of i) uplands, ii) uplands in settlement area and iii) settlement area are estimated from the present land use at about 39,800 ha or 32 %, 19,500 ha or 16% and 7,300 ha or 6% of the watershed area, respectively. These three subject areas amount to 66,600 ha or 54% of the Wonogiri dam watershed.

(3) Annual Average Soil Loss by River Basin

On a sub-basin basis in the Wonogiri dam watershed, annual average soil loss by river basin is summarized in Table 9.2.2 below:

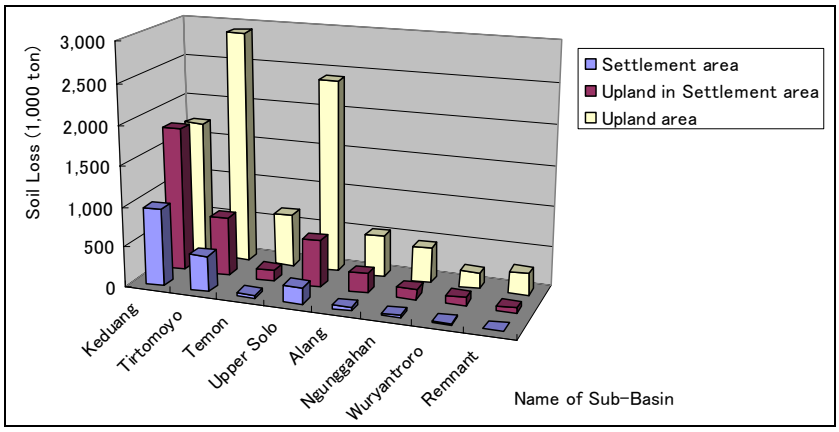
Table 9.2.2 Annual Average Soil Loss by River Basin

(Unit: 1,000 ton/year)

Name of sub-das	Paddy field	Settlement area	Upland in settlement	Upland	Orchard plantation	Forest	Others	State forest	Total soil loss	Extent (%)
Keduang	12	961	1,797	1,726	363	11	4	238	5,112	30
Tirtomoyo	3	450	732	2,911	235	0	7	448	4,786	28
Temon	0	39	136	660	52	0	1	85	973	6
Upper Solo	1	211	588	2,403	298	0	7	299	3,807	22
Alang	1	42	245	521	31	0	6	210	1,056	6
Ngunggahan	1	27	128	438	25	0	6	152	777	4
Wuryantoro	0	18	108	197	35	1	0	1	360	2
Remnant	0	12	58	264	31	2	1	37	405	2
	18	1,760	3,792	9,120	1,070	14	32	1,470	17,279	100

Source: JICA Study Team

As seen above, three watersheds such as the Keduang, Tirtomoyo and Upper Solo are the main producer of soil loss and account for about 80% of the total soil loss in the whole basin. And the pattern of annual average soil loss from i) uplands, ii) uplands in settlement area and iii) settlement area is very different in each sub-basin as shown in Figure 9.2.2 below:

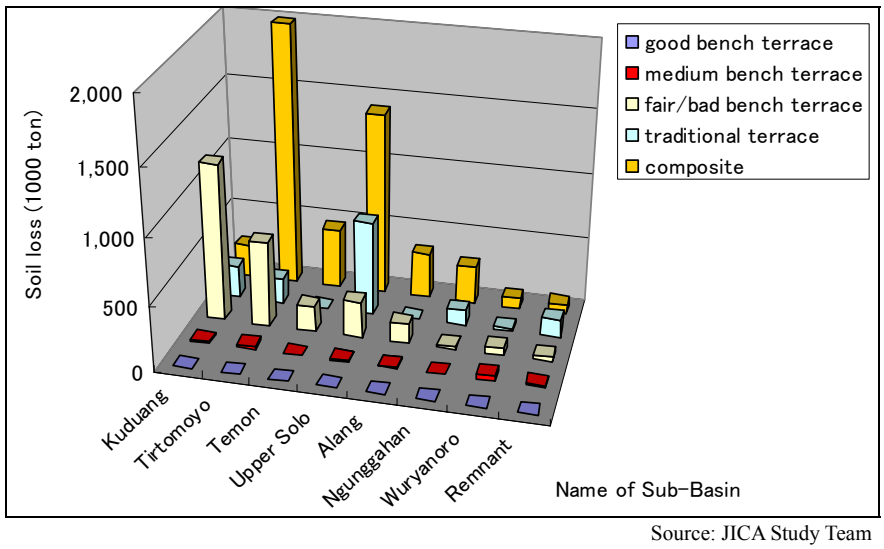


Source: JICA Study Team

Figure 9.2.2 Average Soil Loss of Sub-basin from the 3 Subject Areas Based on Land Use

The main erosion sources of the Tirtomoyo and Upper Solo sub-basins are upland area and in the Keduang it is not upland areas but uplands in the settlements area and settlement area. It is considered that these features mainly come from the different conditions of topography, land use, installation rate of bench terraces, the terrace types and their condition.

Uplands are classified into bench terrace land, traditional bench land and composite land (non-treatment and ridge terrace land). Annual average soil loss from the sub-basin on the basis of terrace types and their conditions of upland areas is summarized in Figure 9.2.3. Annual average soil loss from composite area with association of no terrace lands and ridge terrace lands accounts for over 50% of the total from uplands, of which about 70% comes from the two sub-basins of the Tirtomoyo and the Upper Solo, while in the Keduang the soil loss is mainly not from composite land but from the bench terrace with fair/poor maintenance condition.



Source: JICA Study Team

Figure 9.2.3 Annual Average Soil Loss from Uplands in Sub-basin without State Forest Area

The above results on the subject area for watershed conservation in the Wonogiri dam watershed indicate that annual average soil loss is very different depending on sub-basins. These differences occur owing to characteristics of the sub-basins due to slope steepness, terrace types and their conditions, land use conditions, etc.

9.2.2 Basic Development Concept

In order to realize the urgent objective, this watershed conservation project should be formulated with consideration for soil and water conservation and agricultural production as well as socio-institutional aspect based on lessons learned and the survey results.

With respect to soil and water conservation and agricultural production, the basic development concept for watershed conservation in the Wonogiri dam watershed is set up as follows:

(1) Basic Development Concept from the Viewpoint of Soil and Water Conservation and Agricultural Production

- The soils in the Wonogiri dam watershed are very fine and it is very difficult to effectively trap soils eroded from the watershed with the large scale civil structures such as sabo and check dams. Therefore, the use of large scale civil works should not be adopted.
- The results of the soil erosion tests conducted in this Study showed that an 'improved bench terrace' was very effective for soil conservation. Therefore, such improved bench terraces as well as vegetative conservation measures need to be introduced.
- Improvement of the existing bench terraces, construction of improved bench terraces for the upland areas without terraces, reinforcement of soil erosion prevention for bench terraces through grassing ofr terrace risers and lip improvement.
- Agro-forestry (fruits, estate crops, tree, etc) will be introduced to prevent soil erosion and to increase agricultural productivity as well as to provide the next generation of farmers with resources of other agricultural incomes.
- Introduction of specific improved technology on soil and water conservation measures, cropping patterns, farming practices for increasing crop yields based on the present conditions, land suitability and potential.
- Reinforcement of soil erosion prevention from the fringe of the yard by construction of hedgerows and side ditches.

(2) Basic Development Concept from the Socio-institutional Viewpoint

- In spite of the top-down conservation management system, a community-based conservation management system that fully reflects the conservation-oriented awareness of the farmers in the project area will basically be adopted.
- The community will take a leading role for the watershed conservation from the stage of planning to the stage of monitoring.
- The organization will include the establishment of an implementation committee at village level with transparency in all the process relevant to the project implementation.
- An adequate coordination organization will be established at the district level to smoothly execute the collaborative activities of all stakeholders, communities and implementing agencies for the implementation of the watershed conservation project.
- Proper incentives such as partial subsidy to labor and material costs and training program will be provided to beneficiary farmers to increase the motivation of the people. Also a small-scale village grant fund system will be established.
- Important information on the watershed and the reservoir will be disseminated to the local people, especially to the younger generation.

9.2.3 Approaches to Formulation of Watershed Conservation

(1) Approaches for Soil and Water Conservation, and Agricultural Promotion

- Proposed measures for water conservation are to be formulated through the integration of both soil and water conservation and agricultural approaches based on site specific conditions (land use, terrace conditions, slope, etc.).
- Integration of physical (terrace works) and vegetative measures or integration of soil and water conservation measures with agricultural measures should be made to ensure synergy between both measures.
- Conservation measures should be (readily) accepted by farmers (practitioners) and should be measures which are not sophisticated, easy to introduce, of low material cost and ones enabling agricultural productivity improvement.
- Selection of vegetation is to be made based on the assessment of the past experiences since vegetative measures successfully implemented in the past or recently indicate adaptability of vegetation to the physical and socio-economic environments of the watershed area.
- Formulation of agricultural measures taking into consideration the principles of water erosion control: to reduce raindrop impact on soil, to reduce runoff volume/velocity and to increase the soil's resistance to erosion.
- Agricultural approaches should plan; i) to improve agricultural productivity and increase farm income, ii) to improve soil fertility and physical properties, and iii) to improve cropping systems based on the factors applied in the soil-loss prediction equations.
- Introduction of soil management concepts for watershed conservation because most of the current surface soils in the watershed area appear to be the sub-surface soils of the original soils due to losses of top soils caused by erosion. Improvement of chemical & physical properties of surface soils through application of organic matter and mulching by plant residues will be options to be examined.
- Further diversification of farming activities and farm income sources integrated with watershed conservation measures should be aimed at expansion of tree crops or tree production through agro-forestry development and livestock production integrated with soil and water conservation vegetative measures.

(2) Participatory Approaches for Soil Conservation

- To guarantee the transparency of the project process, an implementation committee should be organized at village level. The members of the implementation committee should be selected in a transparent manner. The major role of the committee is to coordinate with executing agencies, create consensus amongst village people and to monitor all the process from the planning to the post-construction. At least, representatives of villages should be involved as committee members, since the activities will be at village level. The responsibilities as well as a detailed constitution should be discussed in a workshop.
- Local people should be actively involved in all the process from planning to project monitoring. Executing agencies should facilitate (not force) the consensus of local people for the project. In that sense, the planning stage is most important, since people will want to be involved in the decision making on the content of the project. As a result of such efforts, the involvement of the people will enhance the project.
- The result of the village survey indicates the necessity of a qualified facilitator for

such activities as implementation of PRA and workshops. Therefore, a local NGO should be engaged as facilitator through the full process of the project. Considering the present complaints about the local NGOs in the village surveys, the implementation committee should be involved in the selection process of the local NGO.

- The results of the village assessments indicates that villages need technical assistance to assess the soil erosion. In addition, further assistance for topographic surveys, design and cost estimation will be required. Therefore, a consultant should be engaged.
- Demonstration plots for improved terraces with proper vegetation and drainage systems should be established in an appropriate number of villages, so that people can visually understand the impact of improved terraces. The demonstration plots will contribute to the project sustainability through improved understanding of soil conservation resulting from the improved terrace
- Considering the low benefit in the short-term from agriculture improvement in the project, proper incentive to the beneficiaries should be introduced, although some negative impacts caused by heavy subsidies (100% subsidy of labor cost) were identified in an earlier project. The proposed incentives are: i) land registration at no charge for terrace rehabilitation or formulation area, ii) subsidy of labor costs at a proportion of 25-75%, iii) subsidy towards construction materials and agricultural inputs, and iv) training program for local people in capacity building on new agricultural techniques.
- The results of the village surveys indicates a high need for off-farm income. To increase the incentive for maintenance work of project facilities, enhancement of future off-farm income such as agro-processing and wood processing should be considered. Even though the training program for future processing work will not be fruitful in the project period, such training programs will promote future returns and incentives for maintenance work.
- The components for soil conservation will be limited to construction of structures to prevent soil erosion, tree planting, and agriculture measures financed by the project. However, the village action plans indicate various needs such as water resources improvement, market development, road access improvement etc. For such needs, it is proposed that a village grant fund be established under the jurisdiction and financial management of the implementation committee. Even if the amount of the village fund is limited, the motivation of people will be dramatically increased, since people will be able to decide how the fund is used.
- Importance of watershed protection and the Wonogiri dam should be disseminated to the village people. Therefore, pamphlets, posters and village seminars aimed at the younger generation should be included in the project. To increase the project sustainability in the long term, an understanding of the project, especially by the younger generation, is essential.
- Even though the state forest company is implementing the forest rehabilitation program, an explanation to and discussion with local people are required. Therefore, a coordination body with members drawn from the implementation committee/village administration and state forest company should be established for the project.

9.3 Formulation of Watershed Conservation Plan

9.3.1 Formulation of Watershed Conservation Measures

The basis for the formulation of watershed conservation measures has been established by consulting with the project related agencies and the past project experiences, results and findings of the research activities and technical guidelines as listed below:

- Petunjuk Teknis Usahatani Konservasi Daerah Aliran Sungai, Proyek Penelitian Penyelamatan Hutan, Tanah dan Air, Badan Penelitian dan Pengembangan Pertanian, 1990,
- Petunjuk Teknis Pengelolaan Tanah dan Tanaman dalam rangka Pelestarian Alam dan Konservasi Lahan, Direktorat Bina Rehabilitasi dan Pengembangan Lahan, 1990,
- Pedoman Praktik Konservasi Tanah dan Air, BP2TPDAS Indonesia Bagian Barat, 2002, and
- Rekomondasi Teknologi Penelitian Terapan, Sistem Das Kawasan Perbukitan Kritis Daerah Istimewa Yogyakarta, Badan Penelitian dan Pengembangan Pertanian, 1993.

The basic guidelines have been set for; i) proposed land use/agro-forestry development (slope classes and proportion of annual crops & tree crops/trees), ii) slope classes and terrace types, iii) vegetative measures and iv) accommodation of soft components (support programs for executing conservation measures) as discussed below.

(1) Slope Classes and Land Use

The basic plan for the proposed land use or agro-forestry development (proportions of annual crops and tree crops/trees) and slope classes has been studied considering the following issues:

- Sustainable soil and water conservation measures, and agricultural productivity increase and diversification through the promotion of agro-forestry, and
- Mitigating the labor burden in future farming activities through the expansion of fruit/estate crops cultivation to accommodate the gradually aging of farming communities and tendency for the next generation to seek non-farm job opportunities.

The plan for the proposed land use depending on slope classes of subject areas is as shown in the following table.

Table 9.3.1 Slope Classes and Proposed Land Use

Slope Class	Proposed Land Use		Agro-forestry Features
	Annual Crops	Perennial Crops/Trees	
0 - 8%	95%	5%	Mixture of tree crops & trees depending on farmers preference
8 - 15 %	87.5 %	12.5 %	
15 - 25 %	75 %	25 %	Mixture of tree crops & trees under grown with medical crops etc.
25 % - 40 %	62.5 %	37.5 %	
> 40 %	50 %	50 %	

Source: JICA Study Team

(2) Slope Classes and Terrace Types

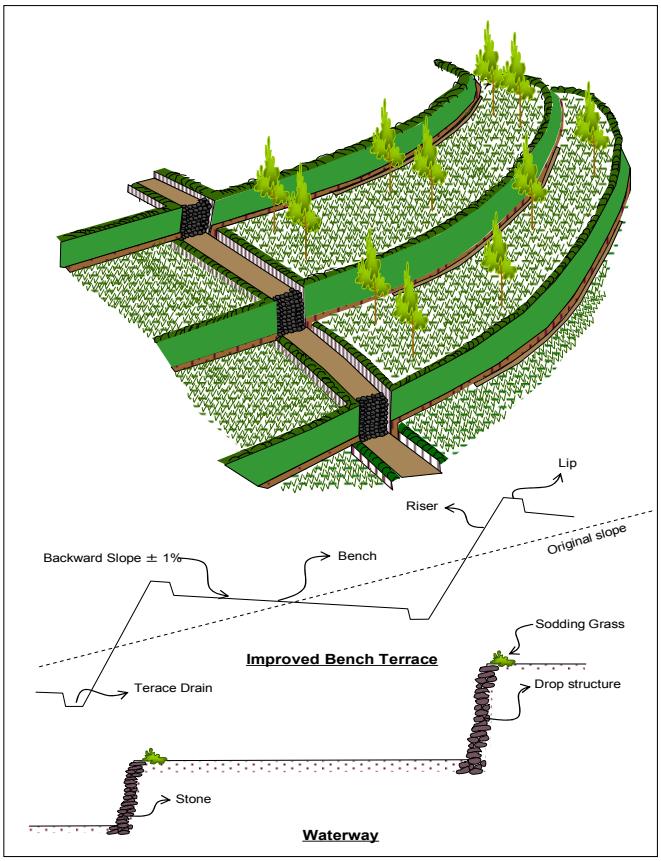
To ensure immediately effective and long-term sustained soil and water conservation in the watershed area, the proposed types of terraces for different slope classes have been set as shown in the following table:

Table 9.3.2 Slope Classes and Terrace Types

Slope Class	Current Terrace Type	
	Bench	Traditional Terrace/Composite*
	Proposed Terrace Type (proposed works)	
0 - 8%	Improved Bench Terrace (improvement of current terrace)	Improved Bench Terrace (terrace formation/upgrading)
8 - 15 %		
15 - 25 %		
25 % - 40 %		
> 40 %		

Remarks; *: Associations of ridge & non-terrace. Source: JICA Study Team

The standard design and image of the improved bench terrace are illustrated in the Figure 9.3.1 below.



Source: JICA Study Team

Figure 9.3.1 Image of Improved Bench Terrace

(3) Vegetative Measures

An assessment has been made vegetative measures used in the past with the aim of incorporating past experience into the formulation of the present study. The criteria applied for the assessment include: i) degree of plant cover, ii) speed or easiness of establishment of vegetation, iii) economic use or value, and iv) field performances[1]. The assessment results showed that in the case of grass, the farmers' preference for plants with a fodder value plant appears to be an essential factor for selection. Further, the adaptability of perennial crops (fruits and estate crops) in the project kecamatans was assessed by Wonogiri Agricultural Services Office. The basic vegetative measures and

[1] The measures and plants employed for individual target areas in past projects have been assessed based on technical documents and the findings of field survey and in consultation with the project implementing agencies (BP DAS Solo & LHKP) and BP2TP DAS.

agro-forestry development directed at bench terraces and vegetative measures to mitigate soil erosion in housing yards are summarized in Table 9.3.3 below:

Table 9.3.3 Basic Vegetative and Agro-forestry Measures in Improved Bench Terrace

Target Place/ Vegetative Measures	Vegetation	Kinds/Species
Terrace Lip - Lip Stabilization	Grass	Elephant Grass, *Panicum muticum,* King Grass
	Shrub	Lamtoro, *Glyricideae speium, Flemingia congesta Roxb etc.*
Terrace Riser - Riser Stabilization	Grass	BB (*Brachiaria brizantha*), BD (*Brachiaria decumbens*), Local creeping grasses
Terrace Bench - Agro-forestry Development	Tree crops/trees	Fruits, estate crops, trees
Housing Yard*	Shrub	*Flemingia congesta Roxb etc.*

Remarks; *: Housing yard in home settlement. Source: JICA Study Team

(4) Accommodation of Soft Components (Support Programs)

An integrated implementation with participation of beneficiaries (farmers/farmer groups) is an essential factor for the successful operation of watershed conservation measures. To ensure such implementation, support programs such as socialization of proposed measures, formation & empowerment of farmer groups, technical training, guidance and demonstration and provision of support are considered to be prerequisites. Accordingly, conservation measures are to be formulated in an integrated manner with support programs.

9.3.2 Classification of Subject Areas and Selection of Target Areas

(1) Classification of Subject Areas

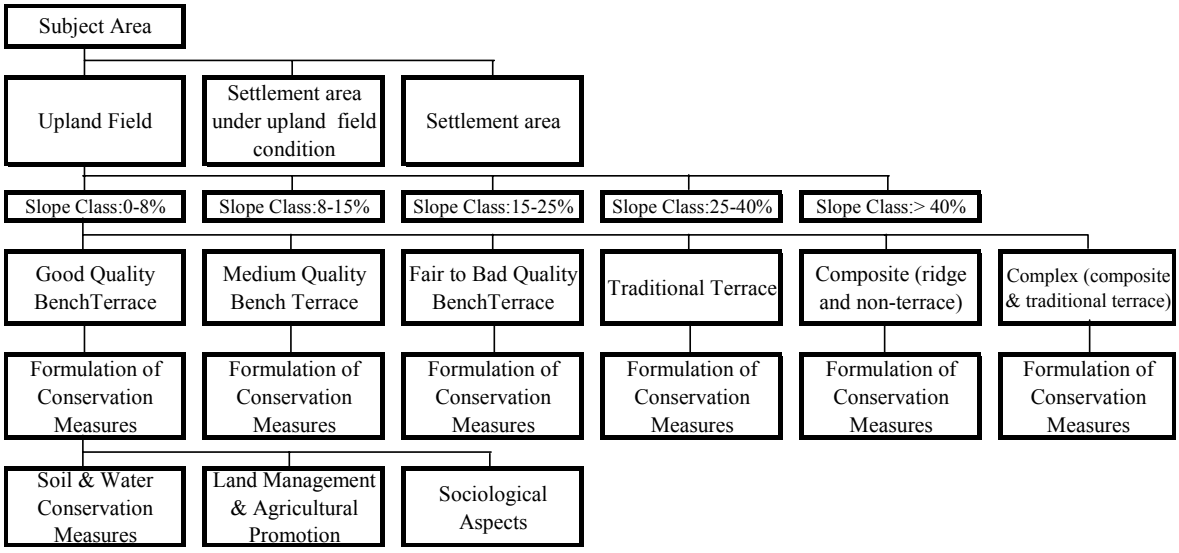
The factors of USLE that could be managed or mitigated through watershed conservation measures are P factor (land conservation factor) and C factor (vegetative/cultivation factor). Accordingly, the subject areas for these factors, discussed in Section 9.1.1, have been classified into sub-units (land units) in order to facilitate formulation of a conservation plan composed of soil and water conservation measures, and agricultural measures. The land conservation factor, which could be targeted for soil and water conservation measures, is the terrace type and condition. The vegetative/cultivation factor, which could be targeted under agricultural measures, will be land use modification through agro-forestry development under the scope of the present study. The criteria applied for the classification of subject areas into land units in the present study are as follows:

Table 9.3.4 Classification Criteria of Subject Area

Factor	Classification Criteria	Code
Land Use	Uplands	U
	Pekarangan*	P
	Housing Yard**	H
Slope	0 - 8%	S1
	8 - 15 %	S2
	15 - 25 %	S3
	25 - 40 %	S4
	40 %	S5
Terrace Type and Condition	Bench Terraced Land	
	- Good quality bench terrace	T1
	- Medium quality bench terrace	T2
	- Fair to bad quality bench terrace	T3
	Traditional Terrace Land	T4
	Composite (mix of ridge and non-terrace)	T5
	Composite/traditional complex	T6

Remarks; *: Uplands in settlement area **: Housing yard in settlement area Source: JICA Study Team

The processes for the classification of subject areas into land units for watershed conservation are illustrated in the following figure.



Source: JICA Study Team

Figure 9.3.2 Classification of Subject Areas into Land Units

Based on the classification criteria for subject area, coding of land units in subject areas is shown in the following table.

Table 9.3.5 Coding of Land Units in Subject Areas

Terrace Type & Condition	Slope Class (%)				
	0-8	8-15	15-25	25-40	>40
Upland Field					
- Good Quality BT *	US1T1	US2T1	US3T1	US4T1	US5T1
- Medium Quality BT	US1T2	US2T2	US3T2	US4T2	US5T2
- Fair/Bad Quality BT	US1T3	US2T3	US3T3	US4T3	US5T3
- Traditional Terrace	US1T4	US2T4	US3T4	US4T4	US5T4
- Composite **	US1T5	US2T5	US3T5	US4T5	US5T5
Uplands in Settlement Area					
- Complex (association of traditional terrace and composite)	PS1T6	PS2T6	PS3T6	PS4T6	PS5T6
Housing Yard	HS1	HS2	HS3	HS4	HS5

Remarks; *: BT = bench terrace **: Association of ridge and non-terrace
Source: JICA Study Team

The subject areas were classified into 35 land units in total based on "Coding of Land Units" for watershed conservation. The total area of each land units is summarized in the following table:

Table 9.3.6 Subject Area Classified by Coding of Land Units (ha) in the Wonogiri Dam Watershed

	Slope Class (%)					Total	(%)
	0-8	8-15	5-25	25-40	>40		
Upland Field							
-Good quality BT*	475	213	147	83	68	980	1
-Medium quality BT	482	418	334	243	319	1,800	3
-Fair/Bad quality BT	4,644	2,508	2,539	2,904	5,263	17,860	27
-Traditional terrace	701	654	935	1,119	1,633	5,040	8
-Composite**	1,351	1,629	2,482	3,366	5,249	14,080	21
Uplands in Settlement Area (association of traditional terrace and composite)	9,526	4,152	2,660	1,617	1,520	19,470	29
Settlement area (housing yard)	2,480	1,620	1,259	933	997	7,290	11
Total (ha)	**19,660**	**11,190**	**10,350**	**10,270**	**15,050**	**66,520**	
(%)	**30**	**17**	**15**	**15**	**23**		**100**

Note; Subject area does not include the area of State Forest.
Remarks; *: BT=bench terrace, **: Association of ridge and non-terrace
Source: JICA Study Team

(2) Selection of Target Areas for Watershed Conservation Project

The target areas for the Wonogiri dam watershed conservation project were selected from the subject areas mentioned above based on the following considerations:

- The Wonogiri dam watershed conservation is to be carried out with members of the local community (villages) as practitioners. The boundary map of villages in Wonogiri dam watershed was prepared based on the topographic maps, by BAKOSURTANAL, on a scale of 1/25,000 made. Village names and areas of village were identified.
- All the information for Wonogiri dam watershed management and data necessary for estimating soil loss were collected and input to the GIS that was developed for this Study.
- Annual average soil loss for each village within the Wonogiri dam watershed was calculated using USLE. Then villages with areas of more than 100 ha and/or annual average soil losses per ha of over 50 tons/ha/year, were selected for the Wonogiri dam watershed conservation.
- For each of the villages selected above, the annual average soil loss for the three kinds of the area of upland field, settlement areas under upland field condition and settlement areas was calculated. Then villages with a total annual average soil loss per ha, from the three kinds of area, of less than 50 ton/ha/year, were excluded from the target subject areas.
- The target area for water conservation project was selected.
- The State Forest area in the Wonogiri dam watershed was excluded from the target subject areas in this watershed conservation project.

The total number of selected villages in the Wonogiri dam watershed is 180 consisting of 83 in Keduang, 29 in Tirtomoyo, 8 in Temon, 25 in Upper Solo, 19 in Alang, 7 in Ngunggahan, 7 in Wuryantoro, and 2 in Remnant. The target subject areas for watershed

conservation in the sub-basins total about 34,400 ha as summarized in Table 9.3.7 below.

Table 9.3.7 Target Subject Area for Watershed Conservation

(Unit: ha)

Land use			Code of land	Keduang	Tirtomoyo	Temon	Upper Solo	Alang	Ngungga-han	Wuryan-toro	Remnant	Total (ha)	(%)
Upland Field	Bench terrace	good	US1T1	0	0	0	0	0	0	0	0	0	0
			US2T1	0	0	0	0	0	0	0	0	0	0
			US3T1	0	0	0	0	0	0	0	0	0	0
			US4T1	0	0	0	0	0	0	0	0	0	0
			US5T1	0	0	0	0	0	0	0	0	0	0
		medium	US1T2	0	0	0	0	0	0	0	0	0	0
			US2T2	23	30	0	0	0	0	86	0	139	0
			US3T2	20	10	0	0	1	16	121	23	191	1
			US4T2	19	17	0	25	19	7	41	22	150	0
			US5T2	12	32	0	18	20	11	28	17	138	0
		fair/poor	US1T3	1	0	0	0	0	0	0	0	1	0
			US2T3	736	217	245	89	378	3	169	11	1,848	5
			US3T3	868	339	166	190	160	13	97	29	1,862	5
			US4T3	807	440	110	211	62	6	38	19	1,693	5
			US5T3	1,322	710	110	262	53	25	22	11	2,515	7
	Traditional terrace		US1T4	7	0	0	0	2	0	0	0	9	0
			US2T4	147	46	7	204	3	49	14	58	528	2
			US3T4	101	100	16	397	7	96	36	99	852	2
			US4T4	58	112	15	439	19	81	15	72	811	2
			US5T4	128	102	4	408	0	120	67	71	900	3
	Composite (ridge and non terrace)		US1T5	51	99	47	61	0	15	12	27	312	1
			US2T5	74	209	96	350	316	176	31	40	1,292	4
			US3T5	92	456	144	664	471	251	50	46	2,174	6
			US4T5	79	694	157	779	449	196	44	53	2,451	7
			US5T5	201	1,128	162	826	337	150	68	84	2,956	9
Settlement area under upland field condition			PS1T5	1,471	341	48	233	103	38	414	47	2,695	8
			PS2T5	1,820	417	199	496	404	136	200	53	3,725	11
			PS3T5	1,071	379	115	457	199	141	80	43	2,485	7
			PS4T5	400	288	44	273	84	59	28	20	1,196	3
			PS5T5	364	195	12	163	46	44	18	8	850	2
Settlement area			HS1	0	1	0	0	0	0	0	0	1	0
			HS2	566	82	40	71	22	13	27	7	828	2
			HS3	363	131	26	96	30	25	14	7	692	2
			HS4	190	158	16	101	20	16	9	9	519	2
			HS5	269	157	6	85	23	15	9	5	569	2
Total (ha)				11,260	6,890	1,785	6,898	3,228	1,702	1,738	881	34,382	100
(%)				33	20	5	20	9	5	5	3	100	

Source: JICA Study Team

9.3.3 Proposed Watershed Conservation Projects

The proposed basic conservation measures consisting of soil and water conservation measures and agricultural promotion measures for the targeted areas of uplands, uplands in settlement area and settlement areas have been formulated for individual land units. The land units are classified by slope classes, and also current terrace type and condition according to the basis for the formulation of watershed management as presented in Tables 9.3.8 and 9.3.9 and briefly discussed in the following.

(1) Uplands with Benched Terrace

Soil and water conservation measures envisaged in uplands with benched terraces are defined as "Terrace improvement works" and include improvement of terrace structures of terrace bench, lip, riser, waterway and drop structure at different degrees depending on current terrace type and condition. Further, the works include vegetative measures for vegetating the terrace lip and riser with grass or shrub for their stabilization.

The agricultural measures are embodied in land management and agricultural promotion methods; i) land management for soil and water conservation, ii) agro-forestry promotion, iii) improvement of settlement area use, iv) crop sub-sector measures and v) livestock sub-sector measures. Details are shown in subsection 9.3.5.

Agro-forestry is considered as a soil and water conservation cum agricultural promotion measure and it is envisaged that it would be introduced over the entire farm land to increase farm income and for mitigating the farm labor shortage problem, which is likely to occur in the near future, in the watershed area. The intensity of the introduction of agro-forestry depends on slope class. With respect to the proposed land use depending on slope class (refer to Table 9.3.1), the rate of introduction of the perennial fruits trees/trees (agro-forestry) was planned as of 50% of the proposed one.

(2) Uplands without Bench Terrace, Traditional Terrace and Uplands in Settlement Area

The conservation measures proposed in upland field without bench terrace, traditional terrace and settlement area under upland field condition are similar to those proposed for upland field with bench terrace and consist of physical measures and vegetative measures.

Rate of implementation of terrace improvements and terrace formation/upgrading works was planned as 80% of the total subject areas of the terrace rehabilitation works with 25-40% steepness and 60% for the subject areas with over 40% steepness because of access conditions to the sites, difficulties of terrace construction due to deep roots of big trees, very steep topographic conditions, uncertainty about the intention of farmers towards terrace making, etc.

Proposed agro-forestry development and land management and agricultural promotion measures in the subject areas are the same as those proposed for upland field with bench terrace.

(3) Settlement Area (Housing Yard)

Measures proposed to mitigate soil erosion in housing yards are to establish hedgerows at the fringes of the yards and to construct side ditches along housing yards. The planting of shrubs at the fringes of villages was planned for 60% of the total settlement areas (housing yards). The preliminary estimated value of the proposed physical and vegetative means for watershed conservation projects per ha is summarized in the following tables:

Table 9.3.10 Preliminary Design Value /ha

	Slope Gradient				
	0-8%	**8-15%**	**15-25%**	**25-40%**	**>40%**
1. Terrace bench works (ha)					
- Improvement	1	1,987	2,053	1,843	2,653
- Construction	3,016	5,545	5,511	4,458	4,706
2. Lip (m/ha)	1,059	2,090	2,860	3,634	4,467
3. Waterway(m/ha)	100	100	100	100	100
4. Drop structure (nos. /ha)	4	12	20	33	50
5. Grass for terrace lip (nos./ha)	4,236	8,360	11,440	14,536	17,868
6. Shrub for terrace lip (nos./ha)	212	418	572	727	893
7. Grass for rise (nos. /ha)	8,224	22,672	37,136	60,464	90,800
8. Side ditch (m/ha)	100	100	100	100	100
9. Hedge row shrubs	3,200	3,200	3,200	3,200	3,200
10. Agroforestry					
- seedlings(nos./ha	16	40	80	120	160
- compost (ton/ha)	0.20	0.5	1	1.5	2
- Chemical fertilizer (kg/ha)	35	90	180	260	350
11. Soil amelioration					
- Compost (ton/ha)	1	1	1	1	1
- Dolomite(tton/ha)	1	1	1	1	1
- NPK fertilizer & seed (pakage)	1	1	1	1	1

Source: JICA Study Team

9.3.4 Reduction of Soil Loss Production

The project works for the watershed conservation project consist of; i) terrace improvement works, ii) terrace formation/upgrading works, iii) agro-forestry development works, iv) farming support programs, v) hedge row works, vi) side ditch construction works, and vii) other support programs for land management and agricultural promotion.

Reduction of soil loss in the Wonogiri dam watershed is expected after implementation of the watershed conservation projects. The water conservation projects will be carried out over about 34,400 ha of the target subject area. The soil loss in the Wonogiri dam watershed after implementation of the projects is estimated by USLE. The parameters used for calculation of soil loss rates after implementation of the project are shown in Table 9.3.11.

Based on the above parameters, the annual average soil loss produced in the whole Wonogiri dam watershed and sub-basins is estimated and shown in the following tables. After the implementation of the projects, it is estimated that the soil loss from the Wonogiri dam watershed will be reduced about 8.08 million tons as per Table 9.3.12. In addition, details on the annual average soil loss rate and annual soil loss per ha at a village level under present conditions and after implementation of project are illustrated in Figures 9.3.3 to 9.3.6.

It may be concluded from the above table that 47% (= 8,077/17,279) of the present total annual average soil loss is trapped or reduced after implementation of the project.

Table 9.3.11 Parameters Used for Estimation of Soil Loss after Implementation of Projects

Parameters		Parameters	
K factor		**P factor**	
(1) Mediteran soil	0.31	(1) Orchard/plantation	0.4
(2) Grumusols	0.48	(2) Bench terrace	
(3) Latosol	0.32	(i) good quality	0.04
(4)Lithosols	0.015	(ii) medium quality	0.2
L factor		(iii) fair/poor quality	0.4
(1) Upland field, Paddy field, Orchard/plantation, upland field in settlement area		(3) Composite (non treatment and ridge)	0.8
(1) Class of slope: <8%	8m	(4) Uplands in settlement area	0.65
(2) Class of slope:8-15%	8m	(5) Terrace of paddy field	0.02
(3) Class of slope : 15-25%	4m	(6)Forest	1
(4) Class of slope: 25-40%	3m	(7) Home settlement area	0.8
(5) Class of slope: >40%	2m	(8) Bare land	1
(2) Other land use	50m	**Rate of implementation of terrace works**	
C factor		Class of slope: <8%	100%
(1) Paddy field	0.05	Class of slope: 8-15%	100%
(2) Home settlement area	0.1	Class of slope : 15-25%	100%
(3) Uplands in settlement area	0.7	Class of slope: 25-40%	80%
(4) Upland		Class of slope: >40%	60%
		Rate of reforestation in state forest	90%
(i) MT-1	0.6	**Rate of agro forest in terrace lands**	5-50%
(ii) MT-II	0.45	**Rate of implementation of planting shrub at fringe of villages in settlement area and constructing side ditches in settlement area**	60%
(iii) MT-III	1		
(ii) MT-II	0.45		
(5) Grassland, Bush land	0.02		
(6) Forest	0.01		
(7)Orchard/plantation	0.3		
(8) Bare land	1		
Water body	0		

Source: JICA Study Team

Table 9.3.12 Reduction of Annual Average Soil Loss in Sub-basin

Sub-basin	Annual Average Soil Loss (1,000 ton)		Reduction of Annual Average Soil Loss (1,000 tons)
	Present condition	After implementation	
(1) Kuduang	5,112	3,237	1,875
(2) Tirtomoyo	4,786	2,331	2,455
(3) Temon	974	457	517
(4) Upper Solo	3,808	1,914	1,894
(5) Alang	1,057	516	541
(6) Ngunggahan	777	317	460
(7) Wuryantoro	360	260	100
(8) Remnant	405	170	235
Total	**17,279**	**9,202**	**8,077**

Remarks: *:This annual average soil loss is estimated under the land use condition in state forest area that 90% of the other land use in the state forest land will be reforested and 10% is assumed to be lost during the growing period due to pest/diseases and other reasons. Source: JICA Study Team

9.3.5 Support Program for Promoting Watershed Conservation Projects

The primary practitioners and beneficiaries of the proposed watershed conservation are dry land farmers in the watershed area. To strengthen support for those farmers in executing the watershed conservation, technical and financial support programs for the implementation of watershed conservation have been formulated in the present study. Reflecting the proposed watershed conservation, the proposed programs consist of soil and water conservation and land management, and agricultural promotion measures. The program components are briefly summarized as follows:

Table 9.3.13 Contents of Support Programs for Soil and Water Conservation Project

Farmers & Farmer Groups Empowerment Package Program	
Programs	Activities
1. Farmer Group Formation Program	Farmer group formation (mass guidance/socialization/workshop & support for formation)
2. Farmer Group Empowerment Program	- Key Farmer Training - Demonstration activities operated by Key Farmer - Mass guidance on conservation measures to all members of farmer groups (farmer field day at demonstration site) - Need inventory of individual farmers for grasses, tree crops & trees to be introduced in the proposed measures
Package Program for Operation/Implementation of Conservation Measures	
Programs	Activities
1. Terrace Formation Guidance Program	- Technical guidance on proposed soil & water conservation measures - Provision of grasses/trees for terrace stabilization - Labor cost subsidy for physical measures (terrace improvement/ formation/upgrading works)
2. Agro-forestry Development Program	- Technical guidance on agro-forestry development - Provision of support package (seedlings & farm inputs) for agro-forestry development envisaged in the proposed measures
3. Farming Support Program	- Technical guidance on farming system improvement - Provision of soil ameliorant and farm inputs
4. Field Guidance Program	- Inception technical guidance & support to beneficiary farmers & farmer groups - Follow-up technical guidance & support
Other Supporting Program	
Program	Activities
1. Field Staff Empowerment Program	- Introduction and periodical refresher training - Technical guidance for field staffs

Source: JICA Study Team

(1) Support Programs for Soil and Water Conservation Project

The proposed soil and water conservation measures have direct and immediate effect on soil conservation, and support programs for practitioner farmers should be accommodated as components of development works to ensure such direct and immediate effects of the measures. The proposed support programs include; i) empowerment of beneficiary farmers and farmer groups, and ii) support programs for operation/implementation of conservation measures. In addition, the empowerment of field staff in providing technical guidance and support to farmers and farmer groups is an essential initial and periodic step to be taken for the efficient and successful implementation of the measures.

(2) Support Programs for Land Management and Agricultural Promotion

The support programs are formulated to strengthen extension activities for land management and agricultural promotion and consist of: i) technology development program, ii) demonstration program, iii) establishment of pilot demonstration field of tree crops & trees, iv) farmer and farmer group training program, v) Palawija seed production program, vi) livestock promotion program, and vii) strengthening of logistic support for extension activities.

(3) Support Programs for Community Development

The support programs are formulated to empower village people and local organizations. The support programs consist of various support for: i) village assessment based on the PRA, ii) formulation of draft village action plan, iii) establishment of implementation committee, iv) guidance and support of village grant fund, and v) education program on watershed conservation.

(4) Monitoring and Evaluation at Village Level

The monitoring and evaluation (M&E) at village level aims to empower village people and local organizations regarding feedback and project modification. The M&E works empowerment approach should include: i) supervision of the works by the village, ii) project impact analysis by the village, iii) necessity for modification of project based on project evaluation, and iv) knowledge building based on lessons learned from the project. The M&E at village level is shown below:

Table 9.3.14 Summary of M&E Plan at Village Level

Category	Item to be monitored	Evaluation
(1) Progress of Projects	Establishment of Committee and groups	The timing of the establishment against the schedule
	Progress of project works and supporting program	The achievement against the schedule
(2) Impact of Project	Record of demonstration plot	Sedimentation decreasing ratio
	No. of project participants by the work and supporting program	Accumulated number of the participants
	Change of land use, cropping pattern, terrace improvement, farming practice, users etc.	Assessment between before and after the project
	Change of village/groups such as income, NGO involvement, conflicts, etc.	Assessment between before and after the project
(3) Feedback to the project design	No. of request to or discussion with the executing agency	Sedimentation decreasing ratio
	Change of the project plan	Assessment between before and after the project

Source: JICA Study Team

CHAPTER 10 INITIAL ENVIRONMENTAL EXAMINATION (IEE)

10.1 Purpose of IEE

An Initial Environmental Examination (IEE) was carried out in accordance with the new JICA Guideline for Environmental and Social Considerations of 2004 as well as the concerned laws, regulations and guidelines in Indonesia. The results of IEE are summarized below and the detail is described in the Supporting Report II Annex No.8.

The main purposes of the IEE study were:

i) To grasp the current physical, natural and socio-economic environmental conditions in the Study Area,
ii) To examine environmental and social impacts likely to be caused by the implementation of candidate project components in the Master Plan,
iii) To develop the outline of an environmental management plan including mitigation measures and monitoring plan, and
iv) To obtain baseline data for the scoping of Environmental Impact Assessment (EIA) for the priority projects to be proposed for the Feasibility Study at the next stage.

10.2 Scope of IEE Study

The IEE Study was comprised of: i) data collection on existing environment, ii) project description, iii) identification and evaluation of conceivable impacts and iv) development of an environmental management plan. The data collection covered the following environmental components:

Table 10.2.1 Scope of Data Collection in IEE

Category	Environmental Components
Physical Environment	Geotechnical feature / Climate / Hydrology / Air quality / Noise and Vibration / Water quality / Bed material quality / Groundwater / Soil
Natural Environment	Vegetation / Terrestrial flora and fauna / Aquatic flora and fauna / Protected species / Biodiversity
Socio-economic Environment	Administrative jurisdiction / Demography / Religion and tribe / Education / Land use / Greenbelt / Industry / Inland fishery / Socio-economic plan / Fluvial navigation / Water use / Public health / Garbage in Wonogiri Reservoir / Historical and cultural heritage / Recreational and tourism / Perception of local people

Source: JICA Study Team

10.3 Methodology

(1) Data Collection

Data collection on existing environment was basically conducted based on secondary data and interview survey. The data and information collected was verified and/or supplemented through the field reconnaissance.

(2) Project Description

The project description was prepared for the candidate project components in the Master Plan and alternatives, describing the size and dimension of structural measures and civil works involved.

(3) Identification and Evaluation of Conceivable Impacts

Identification and evaluation of conceivable impacts to be caused by the implementation

of the Master Plan was basically conducted through identifying and describing the likely impacts analogically based on the size of project components and existing environment and/or using simple but effective models, indicating impact activity which was likely to cause environmental and social impacts. Impact evaluation was done in consideration of the following points:

- Importance of impacts,
- The number of people / households / area to be affected,
- Spatial extent and duration of the impacts,
- Reversibility of the impacts, and
- Possibility to cause secondary impacts.

As a result of the above examination, significant negative impacts were identified.

(4) Development of Environmental Management

Development of the environmental management plan was conducted through the examination of alternatives for mitigating the important negative impacts and for monitoring activities.

10.4 Legal Aspects

Legal aspects of the IEE covered the following: i) Pollution control and Environmental Management, ii) Environmental Impact Analysis (AMDAL), iii) Land acquisition, and iv) Protected species and protected area.

10.5 Candidate Project Components

As discussed earlier in Chapter 8, various alternative countermeasures were devised as listed below.

Table 10.5.1 List of Candidate Project Components

Objective	Candidate Project Components (Alternatives)
Countermeasures for Sediment Deposits and Garbage at Intake	1. Modification of the intake
	2. Relocation of the intake
	3. Garbage trapping structure at the intake
	4. Garbage trapping structure in the Keduang river
	5. Hydro-suction sediment removal system
	6. Hydraulic dredging
Countermeasures for Sediment Inflow from Keduang River	1. Keduang river sediment bypass
	2. Sediment sluicing by new gates
	3. Sediment storage reservoir with new gates in the reservoir
Countermeasures for Sediment Inflow from Other Tributaries	1. Sediment storage dam for sediment removal
	2. Hydraulic dredging in reservoir
	3. Dry excavation in reservoir
	4. Managing of sediments within reservoir by releasing water from the intake
	5. Dam heightening
Watershed conservation	1. Community-based soil conservation
No action	Do nothing for the sedimentation problem in Wonogiri reservoir

Source: JICA Study Team

10.6 Identification of Conceivable Impacts

10.6.1 Description of Conceivable Impacts

Conceivable impacts to be caused by the implementation of alternatives above were examined in terms of three stages; pre-construction, construction and post-construction

(operation and maintenance).

(1) Countermeasures for Sediment Deposits and Garbage at Intake

a) Modification of the intake

Possible impacts are negative ones during construction works, including impacts on air quality (dust and emission gas), noise, water quality and traffic accidents and transportation. The temporary stoppage of intake and discharge into the downstream of the Bengawan Solo River would have an impact on water quality. On the contrary, employment of local residents for construction works and increase of income are likely positive impacts although it is anticipated that they would be relatively minor.

b) Relocation of the intake

Possible impacts are similar to those of the previous case. But the magnitude of the impacts is larger because the size of civil work is much larger than the previous case. In addition, this project component contains tunneling with a length of 570 m, which would require the disposal of excavated materials.

c) Garbage trapping structure at intake

Possible impacts are almost the same in case of a) above. But the periodic removal and disposal of the trapped garbage is needed.

d) Garbage trapping structure in the Keduang River

Possible impacts are almost the same as those of the previous cases. But this measure is expected to mitigate the degradation of water quality in the reservoir owing to the trapping of debris at the inlet area of the Keduang River, including organic garbage, before entering into the reservoir. On the contrary, however, the effectiveness to protect the intake is less than the former three cases because this measure does not directly protect the intake.

e) Hydro-suction sediment removal system

This system is characterized by utilizing the water head difference between the reservoir water level and downstream river water level. There are possible impacts on water quality in the Bengawan Solo River and its aquatic organisms.

f) Hydraulic dredging

This method has relatively few significant impacts based on extensive experience, and the adverse impacts are considered easier to manage except for the procurement of spoil banks. The magnitude of impact depends on the possibility of providing spoil banks.

(2) Countermeasures for Sediment Inflow from the Keduang River

a) Keduang River sediment bypass

This component includes a large scale of civil works and thus there are several negative impacts. This might cause unrest with the local people and some conflict and/or opposition against it before the start of construction work. Huge disposal areas are required for the excavated materials generated by the tunneling. Impacts during construction works include topographic and geologic change, waste of excavated material, drawdown of groundwater level and inconvenience of well

water use, air quality and noise, local traffic accidents and transportation. On the contrary, employment of local residents for civil workers and increase of income can be expected as a positive impact. During the operation stage, the flow of highly turbid water directly to the Bengawan Solo River would increase the suspended solids (SS) in the river more than the existing situation during floods, which might cause impacts on aquatic organisms.

b) Sediment sluicing by new gates

Turbid water from the Keduang River will be released through the new gates. Possible impacts are similar to those in the above case, except for the following:

- Local people's unrest will be minor because this structure is confined within the dam area, and therefore the land acquisition for the disposal of excavated materials is limited.
- There will be minor impacts on groundwater and well water use of local people because this measure may include excavation below the groundwater level.

c) Sediment storage reservoir with new gates in the reservoir

This measure comprises sediment releasing gates and a dike connecting the dam and the panhandle in the reservoir. Impacts include those of the previous case plus the impacts to be caused by periodic sediment releasing. Highly turbid water will be released into the Bengawan Solo River through the gates, which may cause negative impacts on aquatic organisms, especially fish. At the worse, a lot of fish might be killed or injured because, without countermeasures, the high concentration of SS causes a respiratory impediment in fish .

(3) Countermeasures for Sediment Inflow from Other Tributaries

a) Sediment storage dam for sediment removal

Possible impacts are almost the same as those in the case of the "Garbage trapping structure in the Keduang River" described above.

b) Hydraulic dredging in the reservoir

Possible impacts are the same as those in the case of the "Hydraulic dredging" described above.

c) Dry excavation in reservoir

Possible impacts would occur during excavation works, such as impacts on air quality (dust and emission gas), noise, and traffic accidents and transportation. As the scale of this excavation is quite large, these impacts would be significant.

d) Managing of sediments within reservoir by releasing water from the intake

Water release from the intake would be 200 million m^3/y. This might cause a water deficit for irrigation in downstream areas and impacts on paddy fields in the case of inappropriate water release operation. Therefore, it would spawn unrest or conflict in the local communities.

e) Dam heightening

This measure might cause social controversy because it would require large areas of land acquisition and possibly resettlement. Not only the social controversy, but also a large scale of civil work would be needed, which may cause negative impacts on

the local residents. Hence this would be the option to adopt in the future when the storage capacity of the reservoir has decreased substantially.

(4) Watershed Conservation

Technically, no major negative impacts would be expected because no large-scale structures are required. Terrace works are aimed to mitigate soil erosion at upland field, upland in the settlement area and housing yard. Terrace works will include alteration of farm land and the total amount of earth works will be large but the modification of landform at each farm land is minor. The reduction of soil erosion will be synergized by construction of side ditches and vegetative measures. Accordingly, it is predicted that terrace works will not cause any significant negative impacts on topography, terrestrial flora and fauna.

Agro-forestry development is planned to achieve sustainable soil and water conservation and improvement of agricultural productivity by the introduction of mixture of tree crops and trees depending on the slope of upland fields. It may, therefore, not cause any negative impact on terrestrial flora and fauna. The potential impact is on the social unrest and conflict for the introduction of the new agricultural technology. However, this potential negative impact can be mitigated by the supporting programs, which include empowerment of farmers and farmer groups through technical guidance on agro-forestry development. According to the support program, through the intensive training and dissemination, the social unrest and conflict can be minimized. In addition, employment of local residents for the terrace works will increase the income of local farmers, which is expected as positive impacts.

(5) No Action

If there were no countermeasure, the following situation would continue to occur:

- Frequent stoppage of intake and power generation,
- Around 2.8 million m^3 of sedimentation would continue every year, resulting in loss of effective storage from 13.4% in 2005 to around 62% at 100 years later, and
- Decrease of dam safety during floods.

10.6.2 Evaluation of Conceivable Impacts

Conceivable impacts are evaluated using an Impact Matrix. The magnitude of impacts is ranked in the following grades: negligible, minor, medium and significant. Evaluation results are presented in Table 10.6.1, and summarized as follows:

- Countermeasures for the “Sediment deposits and garbage at intake” would not cause significant negative impacts because the size/dimension of the civil works is not large except for the “Relocation of intake”.
- As size and dimension of civil works of the “Relocation of intake” is relatively big, the magnitude of the impact would be larger than for other intake options.
- A hydro-suction sediment removal system would discharge highly turbid water into the Bengawan Solo River, which might cause adverse impacts on fish.
- Countermeasures for the “Sediment inflow from Keduang River” and “Sediment inflow from other tributaries” would cause relatively high negative impacts, because the size and dimension of civil works are large. Moderate adverse impacts would be expected, including the following elements: waste, groundwater, water quality, air quality, noise and vibration, aquatic organisms, land acquisition and resettlement, and people’s unrest and conflict / opposition.
- Community-based soil conservation for the “watershed conservation” would cause

CHAPTER 11 FORMULATION OF MASTER PLAN

11.1 Evaluation of Structural Sediment Management Alternatives

As discussed in Chapter 8, structural sediment management alternatives for i) sediment deposits and garbage at the intake, ii) sediment inflow from the Keduang River and iii) sediment inflow from other tributaries were evaluated independently for comparison of the technical and economical aspects (see Tables 8.6.1 to 8.6.3). Further, an IEE study was carried out for each structural alternative as discussed in Chapter 10. This section, contains the overall evaluation of structural alternatives.

11.1.1 Evaluation of Alternatives for Sediment Deposits and Garbage at Intake

The function of the existing intake should be properly secured. The Keduang River is the primary cause of the current sediment-and-garbage-related problems at the intake. The proposed alternative measures should tackle both garbage and sediment inflows from the Keduang River. The table below summarizes the results of evaluation of the alternatives.

Table 11.1.1 Evaluation Results of Alternatives for Sediment Deposits and Garbage at Intake

Alternative	Construction Cost	Technical Applicability	Environmental and Social Impacts
1) Modification of intake	$3,160,000	Not a sustainable solution because sedimentation will continue year by year over the inlet elevation at the intake.	Irrigation water supply and power generation would be suspended due to temporary stoppage of the intake during construction.
2) Relocation of intake	$8,800,000	Sedimentation will occur at the new intake, although the sedimentation rate is small compared to that at the existing intake. Periodic dredging at the new intake would be required in the future.	Irrigation water supply and power generation would be suspended due to the connection work with the existing intake. Large disposal area will be necessary.
3) Garbage trapping structure at intake	$3,670,000	Blocking of the intake will be solved by periodic garbage removal. Sediment deposits at the intake will be solved by other structural measures.	Water supply would be suspended due to temporary stoppage of the intake during construction.
4) Garbage trapping structure in the Keduang River	$1,370,000	Periodic removal of the trapped garbage will be required. Sediment inflow flow Keduang River continues to enter into the reservoir without being trapped.	Positive impact will occur. Degradation of water quality in the reservoir will be mitigated owing to trapping of garbage from the Keduang River.
5) Dredging by hydro-suction method	$2,875,000	There are operational constraints depending on the reservoir water level because of necessity for a water head difference.	Possible negative impact on water quality of downstream Bengawan Solo River due to release of dredged sediment.
6) Hydraulic dredging	$4,456,700	Most common measure for removing sediment deposits in reservoirs. Huge spoil bank areas are required.	Relatively less impact because of lots of worldwide experience provided with spoil bank areas.

Source: JICA Study Team

Modification and relocation of the intake are inferior to other alternatives because irrigation water supply would be suspended during construction, construction cost is higher, and the sedimentation problem would not be completely solved. These alternatives would not be a sustainable solution for the sedimentation problems in the Wonogiri reservoir.

Garbage trapping structures either in the Keduang River or the existing intake would

limited negative impacts, but spawn several positive impacts, because it will not include large-scale structural measures. All activities are aimed at contributing towards the conservation of soil and improvement of agricultural conditions.

- No action will leave the existing undesirable phenomena of sedimentation problems as they are, including soil erosion and water quality deterioration in the Wonogiri reservoir.

10.6.3 Conclusion and Recommendations

Through IEE for the candidate project components in the Master Plan, conceivable environmental and social impacts were described and evaluated as above. It revealed that there would be several negative impacts whose magnitude is medium or significant as shown in Table 10.6.1. On the other hand, "No action" for existing sedimentation problems in Wonogiri reservoir would shorten the reservoir's lifetime faster than the original design and cause a lot of functional loss in the future, including frequent stoppage of intake and power generation, continuous sedimentation deposits in the reservoir, decrease of effective storage and dam safety.

All the candidate project components are evaluated from the environmental point of view, and the results are shown in Table 10.6.2. As a result of IEE, the following conclusion and recommendations were obtained:

- As for countermeasures for the "Sediment deposits and garbage at intake", countermeasures other than the "Relocation of the intake" have smaller impacts. "Relocation of intake" is not recommended because it will include relatively large-scale civil works, which may cause negative impacts with larger magnitude.
- As for countermeasures for the "Sediment inflow from the Keduang River", the Keduang River sediment bypass is not recommended because it may cause adverse impacts with larger magnitude. Other two countermeasures, "Sediment sluicing by new gates" and "Sediment storage reservoir with new gates" would bring about relatively smaller impacts, and these are concluded to be environmentally fair.
- As for countermeasures for the "Sediment inflow from other tributaries", three countermeasures of the sediment storage dam for sediment removal, hydraulic dredging in reservoir and managing of sediments within reservoir would have smaller impacts. "Dam heightening" is not recommended because it may cause social controversy.
- As for countermeasures for the "Watershed conservation", community-based soil conservation is recommended because it may spawn several positive impacts.

prevent only garbage from entering into the existing intake. These alternatives would be effective in solving the current garbage-related issues at the intake. However, sediment issues at the intake could not be solved by these alternatives.

Hydraulic dredging or a hydro-suction sediment removal system are the most reliable measures to remove the sediments and garbage at intake, though their O&M cost is relatively high. These dredging methods should be applied in conjunction with other countermeasures as the supplemental work.

In conclusion, none of the alternatives above provides a sustainable solution for sediment and garbage issues at the intake. Some of the above alternatives might be used as supplemental components with the selected structural countermeasure.

11.1.2 Evaluation of Alternatives for Sediment Inflow from Keduang River

The results of overall evaluation of the three alternatives for sediment inflow from the Keduang River are summarized in the Table 11.1.2 below.

Table 11.1.2 Evaluation Results of Alternatives for Sediment Inflow from Keduang River

Alternative	Construction Cost, Unit Cost and Released Sediment	Technical Applicability	Environmental and Social Impacts
1) Keduang River sediment bypass	$82,940,000 $10.7/m^3 476,000 m^3/year	Technically applicable. But due to small discharge capacity of bypass tunnel (50 m^3/sec) flood inflow from the Keduang River with high sediment concentration cannot be fully diverted. Considerable volume of sediment flow as well as garbage from the Keduang River enters the Wonogiri reservoir. Modification of intake or periodic dredging at the intake will be indispensable in view of sustainable operation of the reservoir. Huge construction cost will be required.	Serious negative impacts of large magnitude will occur. Huge disposal areas of excavated materials (around 270,000 m^3) spawned by tunneling are necessary. It might be very difficult to secure spoil bank areas near the dam area. Impacts during construction works include topographic and geologic changes, waste of excavated materials, drawdown of groundwater level and inconvenience of well water use, air quality, noise ,unrest of local people, some conflicts/opposition from local people, etc.
2) Sediment sluicing by new gates	$35,630,000 $4.7/m^3 509,000 m^3/year	Technically applicable. Sluicing operation will be applicable at the beginning of wet season only when the water level is the lowest. If the gates are fully opened, considerable amount of garbage would be released to the downstream reach. However, released flow from the gates should be controlled not to exceed 400 m^3/s according to the current reservoir operation rule. There is a risk that the reservoir water level will not reach NHWL at the end of wet season when much water is used for sluicing. More than half of the sediment inflow from the Keduang River will be deposited in the reservoir. Periodic maintenance dredging at the intake is necessary.	Highly turbid water from the Keduang River will be released. The released turbid water might cause negative impacts on aquatic organisms, especially fish. At the worse, high concentration of SS might cause a respiratory impediment in fish. Huge disposal areas for excavated materials (around 800,000 m^3) are necessary. It might be very difficult to secure spoil bank areas near the dam area. Impacts during construction works include topographic and geologic changes, waste of excavated materials, air quality and noise, etc.

Alternative	Construction Cost, Unit Cost and Released Sediment	Technical Applicability	Environmental and Social Impacts
3) Sediment storage reservoir with new gates in the reservoir	\$47,090,000 \$3.8/m^3 1,280,000 m^3/year	Technically applicable. Sediment sluicing (sediment routing) and flushing would effectively utilize the water power (sediment transport capacity) of a natural river with less running cost. As the sediment storage reservoir can be operated independently from the Wonogiri main reservoir, the current operation rule can be applied for the sediment releasing operation. After the reservoir water level reaches NHWL, the sediment releasing operation will be started without using the stored water in the main reservoir.	Highly turbid water from the Keduang River will be released through the new gates. The released turbid water might cause negative impacts on aquatic organisms, especially fish. At the worse, high concentration of SS might cause a respiratory impediment in fish. Huge disposal areas for excavated materials (around 800,000 m^3) are necessary. It might be very difficult to secure spoil bank areas near the dam area. Impacts during construction works include topographic and geologic changes, waste of excavated materials, air quality and noise, etc.

Note: Released sediment volume is estimated from the reservoir sedimentation simulation analysis applying the inflow of the hydrological wet year 1998/99. Unit cost for sediment releasing is estimated based on the construction cost and required O&M cost for 50 years.
Source: JICA Study Team

As mentioned in subsection 10.6.3, the IEE study concluded that the Keduang River sediment bypass was not recommendable because it might cause adverse impacts of high magnitude compared to the other two alternatives. Further the construction cost is huge compared to the other two alternatives.

The structural difference between the two alternatives of sediment sluicing by new gates and sediment storage reservoir with new gates is simply the construction of both closure and overflow dikes in the reservoir. In view of the annual sediment releasing capacity as well as unit cost for sediment releasing, the sediment storage reservoir would be more advantageous although the construction of both dikes needs to be added to the alternative of sediment sluicing by new gates.

From comprehensive comparison of these two alternatives, the sediment storage reservoir was selected as the recommended countermeasure based on fundamental considerations and technical factors as follows:

i) Almost all of the garbage inflow from the Keduang River would be completely retained within the sediment storage reservoir. The existing intake structure would become completely relieved of the current garbage-related issues. The retained garbage in the sediment storage reservoir would be easily released through the new gates when sediment releasing operation is carried out.

ii) At the moment, sediment inflow from the Keduang River is the primary cause of the current sediment-related problems at the existing intake. The majority of the sediment inflow from the Keduang River would be deposited within the sediment storage reservoir. Although small parts of the sediment inflow into the sediment storage reservoir would enter the Wonogiri main reservoir through the overflow dike, sedimentation at the intake would be drastically decreased. This significant technical merit makes it superior to the alternative measure of sediment sluicing by new gates.

iii) In the case of the alternative of sediment sluicing by new gates, the sluicing operation

has to be performed preferably from the beginning of wet season when the reservoir water level is at its lowest. The sluicing operation would not be practical or effective for releasing the stored water in the reservoir when the reservoir water level is around the NHWL, which is likely in the middle of wet season. On the other hand, in the case of the sediment storage reservoir, the sediment inflow from the Keduang River as well as the sediment deposits in the reservoir are able to be released whenever necessary without using the stored water in the Wonogiri main reservoir. The sediment storage reservoir can be operated independently from the Wonogiri main reservoir.

iv) The IEE study indicates necessity of huge disposal areas for the excavated materials (mainly from excavation works for the spillway and forebay) for both alternatives as mentioned in the table above. At the moment, it might be very difficult to secure huge spoil bank areas near the Wonogiri dam. However the excavated materials would be effectively used for embankment and filling materials for construction of closure and overflow dikes.

11.1.3 Evaluation of Alternatives for Sediment Inflow from Other Tributaries

The results of overall evaluation on the five alternatives for sediment inflow from other tributaries are summarized in the Table 11.1.3 below.

Table 11.1.3 Evaluation Results of Alternatives for Sediment Inflow from Other Tributaries

Alternative	Construction Cost	Technical Applicability	Environmental and Social Impacts
1) Sediment storage dam for sediment removal	$225,460,000	Technically applicable but not a practical solution. Around 83 units of storage dam would be necessary for trapping the annual sediment deposition volume of 2.0 million m^3 from other tributaries. Continuous sediment removal works for 2.0 million m^3 will be necessary every year. It would not be practical and applicable.	Huge disposal areas are necessary for periodic sediment removal works. It would be impossible to secure annually spoil bank areas for 2.0 million m^3 of sediments near the reservoir.
2) Hydraulic dredging in reservoir	$44,567,000	Technically applicable but not a practical solution. 10 dredges would be necessary to dispose of the annual sediment deposition volume of 2.0 million m^3. Huge running cost and spoil bank areas are required. It will not be practical and applicable.	Huge disposal areas are necessary for dredging works. It would be impossible to secure annually spoil bank areas for disposing 2.0 million m^3 of dredged sediments near the reservoir.
3) Dry excavation in reservoir	$287,990,000	Dry excavation is not considered to be a sustainable and economical measure. So much equipment such as bulldozers, crawler loaders and dump trucks would be necessary to excavate the annual sediment deposition volume of 2.0 million m^3. Huge running cost and spoil bank areas are required.	Huge disposal areas are necessary for periodic sediment removal works. It would be impossible to secure annually spoil bank areas for 2.0 million m^3 of sediments near the reservoir. Possible impacts on air quality, noise and transportation during the excavation works.
4) Managing of sediment within the reservoir by water releasing from the intake	$0	By use of the maximum intake discharge (70 m^3/s) for power generation, previously deposited sediments are moved toward the dead zone of the reservoir, thereby maintaining or increasing the effective capacity of the	Significant amount of water must be released through power generation, and there is a risk that the reservoir water level will not reach NHWL. This might cause a water deficit for irrigation in the downstream area

		reservoir. However, reliability of this method is considered to be low, because of likely blocking of the intake due to garbage.	and impacts on paddy fields in case of inappropriate water release. It might spawn people's unrest or conflict.
5) Dam heightening	No Estimation	This method involves raising the dam crest to increase the effective storage capacity. Dam heightening would be the option to adopt in the future when the storage capacity of the reservoir has decreased substantially. The Steering Committee on August 22, 2005 concluded that dam heightening was not recommendable.	This measure might cause social controversy because it would require large areas of land acquisition and possibly resettlement. Besides the social controversy, the civil work would be of a large scale, which may cause serious negative impacts on the local residents.

Source: JICA Study Team

As indicated above, it may be that none of the above structural alternatives would provide an economical and sustainable solution. This is due to the following characteristics peculiar to the Wonogiri reservoir:

i) Annual sediment inflow from other tributaries (mainly Bengawan Solo, Tirtomoyo, Temon and Alang Rivers) is estimated to be as massive as around 2 million m^3 and almost all of the sediment inflow is deposited within the reservoir (see Figure 7.4.2). The sediment deposits form a delta and progress gradually towards the center of reservoir. The longitudinal growth rate of delta is very slow. It would take a long time until the delta approaches the area near the intake forebay where sediment deposits can be released through the intake for power generation.

ii) As long as the sediment deposits cannot be released through the intake, a conceivable way is to mechanically remove the sediment deposits in the reservoir and/or to reduce the sediment inflow from entering the reservoir. However because of the limitation of spoil bank area near the reservoir, it is unrealistic to dispose of the sediment deposits from the reservoir as well as the trapped sediment deposits in the sediment storage dams.

iii) The most practical and sustainable measure is to reduce sediment yield as much as possible from the Wonogiri catchment by means of watershed management and conservation, thereby reducing the sediment inflow. Watershed management and conservation works would be superior to the structural alternative measures above.

11.2 Prioritization of Subject Areas for Watershed Conservation

As discussed in Chapter 9, planning for watershed conservation over the Wonogiri catchment was carried out. The selected target subject areas for the watershed conservation project were totally 34,400 ha covering around 180 villages (discussed in subsection 9.3.2). The aspect of IEE for watershed conservation is detailed in sub-section 10.6.1.

For implementation of the watershed conservation management, priority of subject areas was set-up for the step-by-step implementation, since the project cannot be implemented over such a huge area all at once. The basic approach for the prioritization is as follows:

i) All the works should be managed on a village-by-village basis, since the implementation committees will handle the works with technical assistance from the executing agency.

ii) To avoid conflict amongst villages, the project should be implement, as much as

possible, in all the villages located in the same sub-watershed. Local NGOs also noted that equal implementation amongst sub-watersheds is not recommended.

iii) Higher priority should be give to the sub-watershed located near the dam site such as Keduang sub-watershed, since protection of the intake against sedimentation is most important and urgent.

iv) Higher priority should also be given to the sub-watersheds that have higher total annual average soil loss.

v) In setting the development area per annum, the labor availability in the Wonogiri watershed should be considered.

Based on the above approach, prioritization was set-up as shown in the following figure:

Sub-watershed	Rank of Total Annual Soil Loss	No. of Villages	Subject Area (ha)	Implementation Year							
				1st	2nd	3rd	4th	5th	6th	7th	8th
Keduang (1)	1	43	5,700								
Keduang(2)	1	40	5,600								
Tirtomoyo(1)	2	22	5,300								
Tirtomoyo(2)	2	7	1,600								
Upper Solo(1)	3	18	2,000								
Upper Solo(2)	3	7	4,900								
Alang	4	19	3,200								
Temon	5	8	1,800								
Ngunggahan	6	7	1,700								
Remnant	7	2	900								
Wuryantoro	8	7	1,700								
Total		**180**	**34,400**								

: Socialization and planning
: Implementation
: Monitoring

Source: JICA Study Team

Figure 11.2.1 Selected Subject Areas for Implementation of Watershed Conservation

11.3 Formulation of Master Plan

11.3.1 Re-evaluation of Sediment Releasing Capacity of Sediment Storage Reservoir

Sediment inflow varies year by year, highly depending on the future rainfall amount and intensity that are variable in period and location. As mentioned in subsection 8.3.3, the sediment releasing ability of the sediment storage reservoir was estimated based on the reservoir sedimentation simulation analysis. Due to time limitations for the simulation, the simulation was carried out for a reservoir inflow equal to that of the hydrological wet year, 1998/99. In that year, the total volume of sediment inflow from the Keduang River was around 1.71 million m^3, although the mean annual sediment inflow from the Keduang River during 1993-2005 was around 1.18 million m^3. In this sense, the sediment releasing capacity of the sediment storage reservoir is subject to re-evaluation and re-determination.

Further, at the Steering Committee meeting held on July 19, 2006 in Jakarta, it was strongly requested that the construction costs of the proposed countermeasures in the Master Plan be reviewed for possible reductions. Along this line, reservoir sedimentation simulations were carried out to determine the number of gates and design capacity of annual average sediment releasing from the sediment storage reservoir. The simulation results are summarized in Table 11.3.1 below:

Table 11.3.1 Comparison of Sediment Releasing Capacity of Sediment Storage Reservoir

	Unit	Nos. of Gate			
		1	2	3	4
Total Gate Width	m	7.5	15.0	22.5	30.0
Dry Year (2004/05)	1,000 m^3	44	55	58	61
Normal Year (1995/96)	1,000 m^3	659	934	1,043	1,068
Wet Year (1998/99)	1,000 m^3	879	1,115	1,250	1,280
Average	1,000 m^3	527	701	784	803
Direct Consruction Cost	million $	18.7	21.0	24.4	27.8
Unit Cost for "Average"	$/$m^3$	4.1	3.5	3.6	3.9
Unit Cost for "Normal Year"	$/$m^3$	3.3	2.6	2.7	3.0

Note: Unit cost for sediment releasing is estimated based on the direct construction cost and O&M cost for 50 years. Details of the simulation results is refer to Supporting Report I Annex No.4.
Source: JICA Study Team

The total reservoir inflow volumes are around 0.8 billion m^3 in a dry year, 1.3 billion m^3 in a normal year and 1.5 billion m^3 in a wet year. The mean annual inflow volume is around 1.2 billion m^3. As seen in the table above, the inflow volume in a dry year is extremely small as compared with that in the normal year. Accordingly, the frequency of sediment releasing operation becomes nil or very low in a dry year, as no excess water is available. In terms of the unit costs above, a total gate width of 15.0 m (= B7.5 m x 2 nos.) results in the lowest cost. The design capacity of annual sediment release is adopted as 0.7 million m^3/year.

11.3.2 Prioritization of Proposed Structural and Non-structural Countermeasures

As mentioned in Section 7.4, prioritization of the proposed structural and non-structural countermeasures was set up below:

Table 11.3.2 Prioritization of Proposed Countermeasure

Phasing of Implementation	Purpose
1. Urgent Countermeasure	▪ ***Keep proper function of the intake***
a. Sediment Storage Reservoir with New Gates	▪ Pass through and flush out the inflow of sediment and garbage from the Keduang River
b. Watershed Conservation in Keduang catchment	▪ Mitigate sediment yield in the Keduang catchment and thereby reduce sediment inflow into the reservoir
c. Periodic Maintenance Dredging at Intake	▪ Avoid blocking at the intake due to sediment deposits and garbage
2. Mid Term Countermeasure	▪ ***Keep in order the Wonogiri reservoir functions***
a. Watershed Conservation in other tributaries	▪ Mitigate sediment yields in other tributaries catchment and thereby reduce sediment inflow into the reservoir
3. Long-lasting Countermeasure	▪ ***Keep in order the Wonogiri reservoir functions***
a. Rehabilitation of Watershed Conservation Areas	▪ Keep in order the conserved Wonogiri watershed function

Source: JICA Study Team

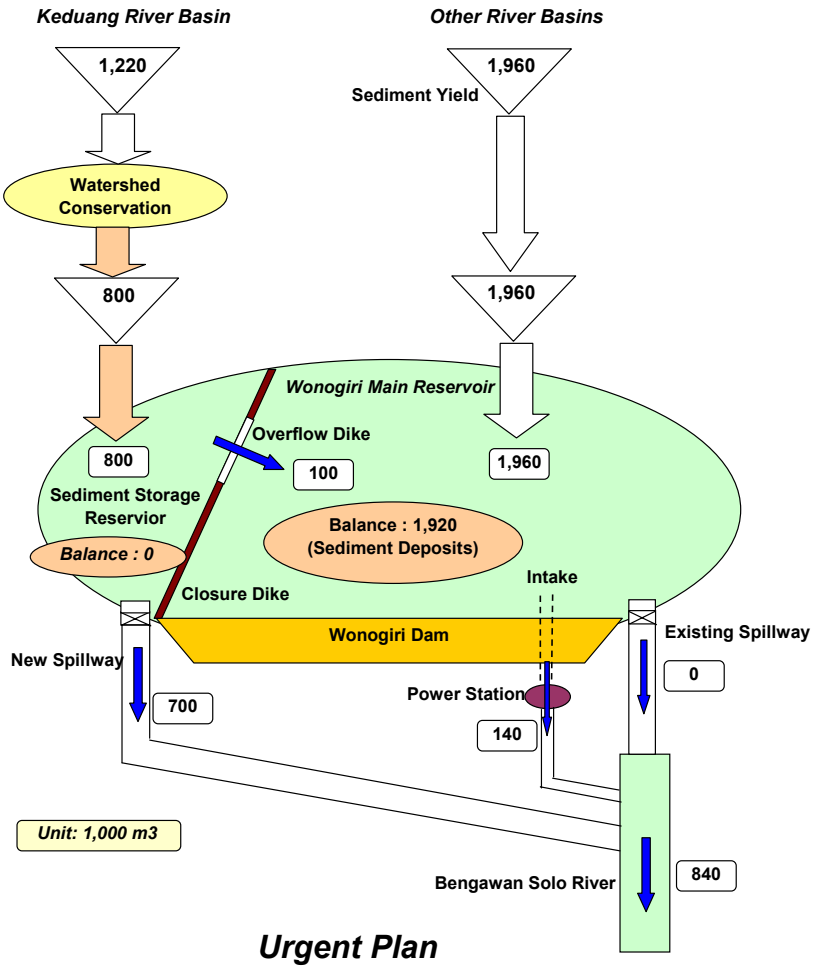
Urgent countermeasures should preferably be commenced as early as possible to keep proper function of the intake. Since totally the sediment yield in the other tributary basins is higher than the Keduang River basin, which would continue even after the completion of the urgent countermeasures, the mid-term countermeasures should be commenced at the earliest opportunity to mitigate sediment yield and thereby to prolong the dam

reservoir lifetime.

The long-lasting countermeasure is categorized as continuous rehabilitation works to be implemented after completion of the watershed conservation works of the mid-term countermeasures. This countermeasure aims at maintaining the soil erosion rate at the design level to avoid re-deterioration of cultivated farmlands and keep them in a preferable state. The long-lasting rehabilitation works are intended to be implemented using local budgets and under a funding framework that will transfer some of the benefit from the downstream communities of the Wonogiri dam to the upstream ones.

11.3.3 Urgent Countermeasures for Garbage and Sediment Inflow from Keduang River

Figure 11.3.1 below shows the design sediment balance in the Wonogiri reservoir after the implementation of urgent countermeasures.



Source: JICA Study Team

Figure 11.3.1 Design Annual Sediment Balance in the Wonogiri Reservoir by Urgent Countermeasures

Soil erosion is a significant problem in many areas of the Wonogiri watershed. As discussed in Chapter 9, the watershed management and conservation plan was formulated in the framework of basin-wide sediment management of the Wonogiri dam. For the Keduang watershed, it was proposed that it should be implemented for a total area of 11,260 ha covering 83 villages in total (see Figure 11.2.1). If properly undertaken and intensively managed, watershed conservation would be effective for reducing soil erosion

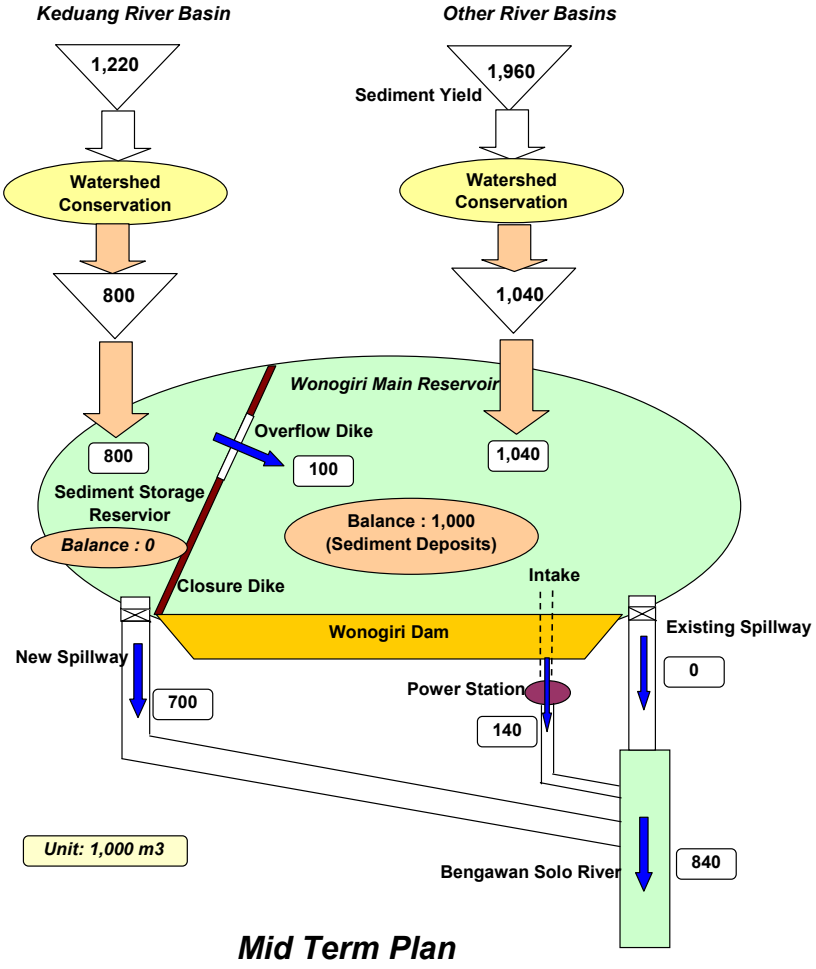
and eventually in reducing sedimentation rate in the Wonogiri reservoir. After implementation of the Keduang watershed conservation, there is expected to be on average a reduction of around 0.42 million m^3 of sediment inflow every year. The annual sediment inflow from the Keduang River would be reduced from 1.22 m^3 to 0.80 million m^3.

As shown in the sediment balance above, the sediment volume that overflowed into the Wonogiri main reservoir from the sediment storage reservoir through the overflow dike, and the sediment volume released from the intake through hydropower generation were estimated at 0.10 million m^3/year and 0.14 million m^3/year respectively by the reservoir sedimentation simulation analysis. Consequently the annual sediment deposits in the Wonogiri reservoir are 1.92 million m^3 (=1.96+0.10-0.14). This is still larger than the original design sedimentation rate of 1.2 million m^3/year.

11.3.4 Mid Term Countermeasures for Sediment Inflow from Other Tributaries

As discussed in subsection 11.1.3, a sediment storage dam for periodic sediment removal, hydraulic dredging and dry excavation in the reservoir were conceived, for comparison, as alternative structural countermeasures for sediment inflow from other tributaries. These alternatives all aim at removing sediments deposited previously in the reservoir instead of reducing sediment inflow into reservoir. Each alternative has technical merits and demerits under the hydraulic and reservoir conditions. Considering the huge volume of sediments to be deposited in the reservoir in the coming 100 years, these alternatives are not recommended because very limited areas are available for disposal of removed sediments. This has led to the conclusion that the most practical and appropriate way is to reduce sediment inflow as much as possible. Therefore, it is judged that the best way is to reduce the sediment yield rate by implementing watershed conservation.

Figure 11.3.2 below shows the design sediment balance in the Wonogiri reservoir after the implementation of mid term countermeasure. The watershed conservation project would be implemented for the other tributaries with a total area of around 23,120 ha that covers 29 villages in the Tirtomoyo, 8 villages in the Temon, 25 villages in the Upper Solo, 19 villages in the Alang, 7 villages in the Ngunggahan, 7 villages in the Wuryantoro River basins and 2 villages in the remaining area. After implementation of these watershed conservation projects, the annual sediment inflow into the Wonogiri Reservoir is expected to be reduced by 0.92 million m^3. The annual sediment inflow from other tributaries would be reduced from 1.96 million m^3 to 1.04 million m^3. Consequently the annual sediment deposits in the Wonogiri reservoir are 1.00 million m^3 (=1.04+0.1-0.14). The sediment balance satisfies the basic concept that the allowable annual sediment deposition rate should be less than the original design sedimentation rate. The watershed conservation project can be downsized to adjust the sediment balance to the design sedimentation rate.



Source: JICA Study Team

Figure 11.3.2 Design Annual Sediment Balance in the Wonogiri Reservoir by Mid Term Countermeasures

11.3.5 Necessity of Maintenance Dredging

This Study presumes that sediment inflow into the Wonogiri reservoir would continue at a rate of some 3.18 million m^3/year (= 1.22 million m^3/year from the Keduang River and 1.96 million m^3/year from other tributaries) in coming 100 years. Actual sediment inflow will however depend largely on the future rainfall amount and intensity. Meteorological condition varies year to year. There is still a possibility that hydrologically extreme event might occur. When such an extreme case takes place, massive sediment inflow and the subsequent sedimentation may occur.

Besides, there is still a possibility that some garbage from the Keduang River through the overflow dike and/or previously deposited garbage may drift down to the intake. In this respect, it is recommended that maintenance dredging be conducted in the forebay area of the intake to cope with extreme situations of sediment and garbage inflow.

11.4 Cost Estimate

11.4.1 Basic Conditions and Assumptions

The basic conditions and assumptions for estimating construction costs of the proposed components of the master plan are as follows:

(1) Price Level

Price level is as of December 2005.

(2) Exchange Rate

The following exchange rate as of December 2005 is adopted:

US$ 1.0 = Y 119.63
US$ 1.0 = Rp. 10,035.3
(Yen 1.0 = Rp. 83.9)
where, US$: U.S. Dollar
Rp. : Indonesian Rupiah
Yen : Japanese Yen

(3) Currency of Cost Estimate

Cost is estimated in U.S. Dollar.

(4) Cost Components

Cost for works comprises i) permanent works, ii) temporary works, and iii) physical contingency. Overhead and profit are included in each of the works. Price contingency is not included in the cost.

Cost for the permanent works is estimated to be a total of i) major works and ii) other smaller works. Cost for the major works is estimated by multiplying the work quantity by the work rate (unit price). Cost for other smaller works is estimated by multiplying the total cost of the major works by a ratio.

In the watershed conservation project, implementation of all works is carried out by manpower. Financial cost for watershed management program is estimated taking into consideration participation of farmers for construction of the project works such as civil works, terrace upgrading/construction and stabilization of trees. The amount of the necessary manpower requirement to be supplied by the farmers has been based on the result of participatory rural appraisal (PRA) in September 2005 as shown in the following Table. Material cost will be provided by the project.

Table 11.4.1 Provided Labor Contribution by People in Watershed Conservation Program

Item	Civil work, terrace upgrading/construction	Stabilization of lip and terrace
Provided Labor contribution by people	25%	50%

Source: JICA Study Team

(5) Government Administration and Engineering Services Cost

Government administration and engineering services cost is assumed at 15% of the direct construction cost of the structural measures. As for the watershed conservation project, 11% of the direct cost is applied.

(6) Physical Contingency

Physical contingencies are separately assumed to be 20% for the total cost of the direct cost, government administration cost and engineering services cost, and 10% for the watershed conservation project.

(7) Government Taxes

Government taxes are excluded in the cost estimate.

11.4.2 Project Cost

Total project cost for the master Plan was estimated as summarized in Table 11.4.2 below. Tables 11.4.3 to 11.4.5 present detailed breakdown of the estimated costs.

Table 11.4.2 Summary of Project Cost

Countermeasures	Total Cost (US$ thousand)
1. Urgent Countermeasures for Garbage and Sediment Inflow from Keduang River	
a. Sediment Storage Reservoir with New Gates	36,070
b. Watershed Conservation in Keduang Catchment	13,835
c. Procurement of One Dredger	3,586
Sub-total	***53,491***
2.Mid Term Countermeasures for Sediment Inflow from Other Tributaries	
a. Watershed Conservation in Tirtomoyo Catchment	10,433
b. Watershed Conservation in Upper Solo Catchment	11,049
c. Watershed Conservation in Temon Catchment	2,418
d. Watershed Conservation in Alang Catchment	4,856
e. Watershed Conservation in Ngunggahan Catchment	2,807
f. Watershed Conservation in Wuruyantoro Catchment	2,148
g. Watershed Conservation in Remnant Catchment	1,349
Sub-total	***35,060***
Grand Total	**88,551**

Source: JICA Study Team

11.5 Implementation Program

11.5.1 Overall Implementation Schedule

The overall implementation schedule for the proposed countermeasures for sedimentation issues in the Wonogiri reservoir is presented in Table 11.5.1 below.

Table 11.5.1 Overall Implementation Schedule of Master Plan

Measures	2006			2010		2015					2020					2025				
	5 years					10 years					15 years					20 years				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 ***URGENT COUNTERMEASURES***																				
(1) Financial Arrangement																				
(2) Sediment Storage Reservoir with New Gates																				
(3) Watershed Conservation in Keduagn River Basin																				
(4) Procurement of One Dredger and Maintenace																				
2 ***MID TERM COUNTERMEASURES***																				
(1) Financial Arrangement																				
(2) Watershed Conservation in Other Tributaries																				
1) Tirtomoyo																				
2) Upper Solo																				
3) Alang																				
4) Temon																				
5) Ngunggahan																				
6) Wuruyantoro																				
7) Remnant basins																				
3 ***LONG-LASTING COUNTERMEASURES***																				
(1) Rehabilitation of Watershed Conservation Areas																				
4 ***MONITORING***																				
Periodic Monitoring for Sedimentation at Intake																				
Periodic Monitoring for Sedimentation in Reservoir																				

Legend: Financial Arrangement, Design, Implementation, Procurement

Source: JICA Study Team

11.5.2 Periodic Monitoring of Sedimentation

(1) Monitoring of Sediment Inflow and Sediment Deposition in Reservoir

It is forecast that if watershed conservation works were properly undertaken, the reservoir sedimentation rate would be effectively reduced due to reduction of sediment yields in the upper catchment. It is recommended that the reduced sediment yields be estimated and monitored through reservoir sedimentation surveys. In this respect, periodic reservoir surveys should be continued preferably every 3 years. The periodic reservoir survey will enable an estimate to be made of the sediment volume accumulated in the reservoir at intervals of three years.

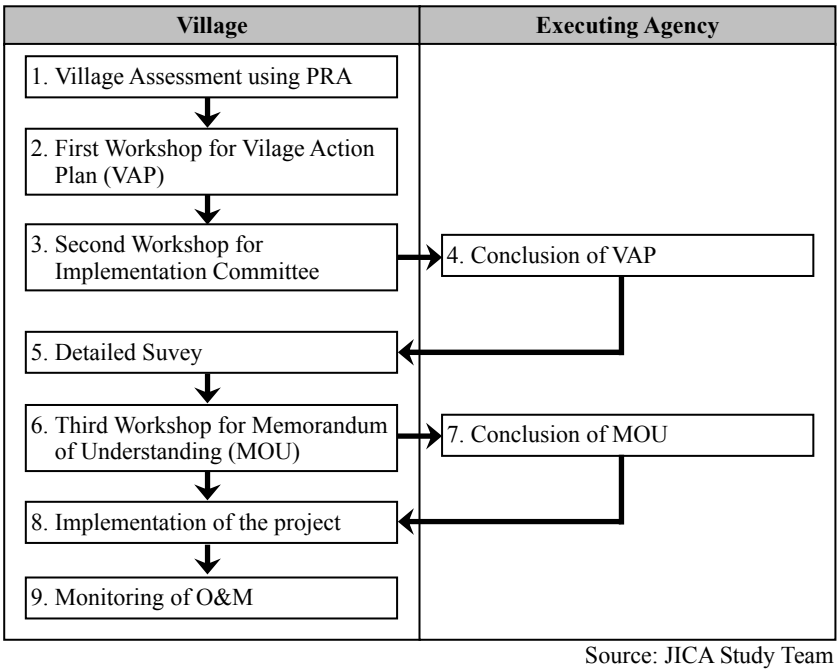
(2) Monitoring of Sediment Deposits at Intake

PBS is implementing periodic monitoring on the sediment levels on the approach channel of the intake structure. Although it is expected that the problem on blocking of the intake structure will be resolved through implementation of the sediment storage reservoir, periodic sediment monitoring in front of the intake should be continued preferably every two months during the wet season.

11.5.3 Implementation Procedure of Watershed Conservation Projects

(1) Procedure

Local people are the most important factor in good watershed conservation and management. Considering participation by the community and local people, it will be important that, i) they understand soil conservation through participatory rural appraisal (PRA) and other surveys, ii) they are able to make initiatives through preparation of village action plan (VAP) and formulation of the implementation committee, iii) responsibility is shared between executing agency and the village through formulation of a memorandum of understanding (MOU). Therefore, the nine steps illustrated in the figure below is the procedure proposed:



Source: JICA Study Team

Figure 11.5.1 Implementation Procedure of Watershed Conservation Projects

The detailed explanation of each step is as follows:

1) Village assessment

The village assessment using PRA should be made in order to utilize local knowledge and increase the understanding of the people on soil erosion. The PRA includes: i) informal interviews, ii) focus group discussions, iii) village history for soil conservation and forestation, iv) participatory mapping, v) institutional relation diagram (Venn Diagram), vi) field transect to identify the eroded location, vii) livelihood and gender role analysis, viii) seasonal calendar, and ix) matrix ranking.

2) First village workshop

After the village assessment, a village workshop should be held for formulation of an action plan for soil conservation and consensus building amongst village people on priority of needs and erosion locations. The workshop includes, i) results of the village assessment, ii) group discussions by topics (ex. review of erosion location, formulation of action plan, and SWOT analysis etc.), iii) presentation of each group, iv) discussion and conclusion, and v) next step.

3) Second village workshop

The implementation committee should be organized in the village through consensus building process of the second village workshop. It is noted that members of implementation committee should be selected with transparency. The major role of the committee is to create consensus amongst village people and to monitor all the process from the planning to the post-construction.

Representatives of stakeholder groups related to the proposed works should be included as members of the committee. Members will involve representatives of the village, farmers' groups, women's groups, soil conservation groups etc. At least, the members should involve representatives of the village, since the activities will be at a village level.

4) Discussion with executing agency and Kecamatan (sub-district) office

Based on the village action plan for soil conservation, the executing agency and Kecamatan office with discuss further steps (items to be involved in the project, schedule and content of the detailed survey) with the implementation committee.

5) Implementation of detailed survey

A meeting will be held with the executing agency for explanation of discussion results as well as contents and schedule of the detailed survey. Under the initiative of the implementation committee, the village will implement the detailed survey with technical and financial assistance of the executing agency. The detailed survey includes: site selection, topographic survey of the proposed site, design, and cost estimation.

6) Third village workshop

Results of the detailed survey will be explained and the implementation plan will be discussed in the third workshop. Based on the conclusion in the workshop, draft MOU will be prepared for further discussion with the executing agency.

7) MOU conclusion

Based on the result of the detailed survey, a MOU on the project should be concluded between the executing agency and the implementation committee. The

MOU should include: i) components and the work volume covered by the project, ii) responsibility sharing in the implementation stage, and iii) responsibility sharing in the operation and maintenance stage,

8) Implementation of project

Before the commencement of the project, the contents of the MOU and the procedure of the project will be explained to the whole village. The project includes the following components; i) terrace improvement works, ii) terrace formation/ upgrading works, iii) village grand fund, iv) monitoring and evaluation, v) support programs for soil and water conservation measures, vi) support programs for land management and agricultural promotion measures, and vii) support programs for community development.

All the work including administration should be monitored by the implementation committee. The issues and their countermeasures should be discussed from time to time. A progress report will be prepared on a quarterly basis and submitted to both the Kecamatan office and the executing agency.

9) Monitoring of O&M and socialization of the whole village

After the project implementation, the monitoring by the implementation committee should be continued. The committee should monitor the operation and maintenance conditions of the project facilities including terrace, water way, drop structures, planted trees etc. The monitoring results should be explained and discussed under the socialization program.

11.5.4 Implementation Arrangements at Field and Village Levels

(1) Organizational structure

In the watershed area, the farm holding size is small and conservation measures will be dispersed with limited effect if they are just introduced individually by interested farmers. Therefore, community based introduction of measures is envisaged, which will dictate understanding and agreement on proposed measures to be followed by small scale farmers. Local people will be the most important factor in good watershed conservation and management. Therefore, communities at field and village level should take on a responsible role for the proposed watershed conservation, from the planning stage. The collaborative activities of all stakeholders, communities and implementing agencies are essential for the implementation of the conservation.

The proposed implementation arrangement at field and village level, therefore, should be initiated with the implementation committee to be established at the village level. The members of implementation committee should be selected with transparency in the beginning of the implementation under the guidance and support of the executing agency or NGOs or by the both. The formation and empowerment of beneficiaries or practitioner groups, Kelompok Konservasi Tanah dan Air (K2TA; Soil & Water Conservation Farmer Group) will also be promoted. Such formation and introduction empowerment guidance is to be executed a year prior to the implementation of conservation measures, after the socialization of the measures or project activities. Following the formation of K2TA, a K2TA empowerment program should also be implemented in the 1st year. After such a preparatory stage in the 1st year, terrace improvement works, terrace formation/upgrading works consisting of physical measures, vegetative measures, a farming support program and agro-forestry development program are to be implemented from the 2nd year as shown

in Figure 11.5.2.

The proposed organization set-up at the farmer group level for the implementation is K2TA as shown in Figure 11.5.3.

(2) Role and Responsibility amongst Stakeholders at Village Level

To avoid confusion amongst stakeholders, the roles and responsibilities should be defined. The roles and responsibilities should be finalized in the workshops with consent amongst the people. However, the tentative roles of each component are as follows:

Table 11.5.2 Role of Stakeholders Concerned

Component	Executor	Supervisor	Supporter
(1) Terrace Improvement Works	K2TA	Implementation Committee	Extension staffs (PPL/PKL) and Executing Agency
(2) Terrace Formation/Upgrading Works	Contractor and K2TA	Implementation Committee	Extension staffs (PPL/PKL) and Executing Agency
(3) Village Grant Fund	Village people	Implementation Committee	NGO and Executing Agency
(4) Monitoring & Evaluation	K2TA	Implementation Committee	NGO and Executing Agency
(5) Support Programs for Soil & Water Conservation Measures	Extension staffs (PPL/PKL) and Consultant	Implementation Committee	Executing Agency
(6) Support Programs for Land Management & Agricultural Promotion Measures	Consultant	Executing Agency	-
(7) Support Programs for Community Development	K2TA and other village organizations	Implementation Committee	NGO and Executing Agency

Source: JICA Study Team

Based on the above role of each organization concerned, the tentative responsibility of each stakeholder will be as follows:

Table 11.5.3 Responsibility of Stakeholders Concerned

Stakeholders	Responsibility
Farmers	Operation and maintenance of individual land
K2TA	Terrace improvement and upgrading
Contractor	Terrace formulation and supply of materials
Implementation Committee	Supervision of all work, coordination with executing agency, and operation of village grant fund
Extension staffs (PPL/PKL)	Technical training and guidance to K2TA
Consultant	Technical training and guidance to Extension staffs
Executing Agency	Supervision of project implementation, coordination with Implementation Committee, and operation of project fund

Source: JICA Study Team

Role and responsibility of the stakeholders concerned in the above are subject to further study in the feasibility study stage.

11.5.5 Monitoring and Evaluation Plan

The project design matrix (PDM) was prepared for each project component of the master plan as shown in Tables 11.5.4 and 11.5.5. The monitoring and evaluation plan for community-based watershed conservation is discussed in subsection 9.3.5.

11.6 Project Evaluation

11.6.1 Methodology

The viability of the proposed countermeasures for sedimentation in the Wonogiri reservoir (the Project) in the master Plan is based on the economic evaluation. The economic evaluation is conducted in terms of the Economic Internal Rate of Return (EIRR) and cost benefit analysis (B-C).

11.6.2 Economic Cost Estimate

Conversion factors are used to transform the financial prices into economic prices. As the economic evaluation is done from the point of view of the national economy, the conversion factors serve to eliminate distortions in the financial prices, such as taxes, subsidies, price controls, transfer payments, etc. The standard conversion factor (SCF) is set at 0.9 for the price distortions. The following conversion factors are also set with reference to similar projects in Indonesia.

Table 11.6.1 Conversion Factors

No.	Item	Conversion Factor
1.	Standard Conversion Factor	0.90
2.	Civil works	0.71
3.	Equipment	0.90
4.	Engineering services, design, survey	0.90
5.	Administration	0.90
6.	O&M cost	0.80
7.	Unskilled labor	0.75

Source: The Study under the JBIC SAPS for 24 Infrastructure Rehabilitation Projects; JBIC, 2001.
Notes: Comparison with conversion factors used under ADB study: "Project Completion Report on the Central Java Groundwater Irrigation Development Project Loan 1126-INO", November 2001.

Table 11.6.2 shows the summary of the estimated economic cost of the Project. Detail of economic cost estimation for the watershed conservation project is given in Table 11.6.3.

11.6.3 Economic Benefit Estimate

(1) Types of Benefit

Economic benefits of the Project are generated from; i) securing the Wonogiri reservoir function and ii) conserving the Wonogiri watershed. The former is expected to extend the reservoir lifetime for providing flood protection benefits, hydropower benefits, irrigation benefits, and domestic and industrial water supply benefits. The latter is expected to bring benefits in the form of increased agricultural production. The details are described below:

(2) Benefit of Extension of Reservoir Useful Life

The incremental benefits are the difference between the benefits under "With Project condition" and "Without Project condition". The conceivable benefits accrue from prolonging the useful life of the reservoir.

For the downstream incremental benefits "Without Project condition" assumes that when the reservoir sub-area for the Keduang River is completely filled with sediments in the year 2022, the function of the Wonogiri dam for providing irrigation and domestic water supply will cease from 2022. "With Project condition" assumes progressive decrease of the effective storage of the reservoir, reaching 28% of the original capacity after 50 years as described in Section 7.2. The progressive decrease of the effective storage will cause

the proportional decrease of the annual benefits of the Wonogiri reservoir. However, flood mitigation benefit is not envisaged because no sedimentation would occur in the flood control zone of the reservoir and therefore the flood control function would still be secured for the next 100 years.

Hydropower benefit:

The power supply from the Wonogiri hydropower station is very small. In 2004, kabupaten Wonogiri purchased 151,119MWh[1] and PLTA generated 33,711MWh. At present, the PLTA Wonogiri is an integrated part of the Java-Madura-Bali power generation system (JAMALI). The installed capacity of JAMALI is 18GW. Within the whole system, hydropower accounts for less than 5% of total power generation. That is still very important for the peak load (between 17:30 and 20:00). The current installed capacity of the JAMALI system is critically small during the peak load (14,500MW of installed capacity against 13,700MW of peak load). The imbalance between electricity supply and demand is an important constraint for JAMALI customers. The increase for electricity demand is projected at 8-10% annually.[2] Therefore, it is important to maintain all existing generating capacity, even though the installed capacity of the Wonogiri power station is as small as 12.4MW.

The annual benefit of Wonogiri hydropower station is estimated at US$ 6.6 million based for the reasons described hereunder.

The economic benefit of hydropower can be estimated based on the avoided alternative cost. The alternative cost includes capacity benefit and energy benefit. The capacity benefit can be estimated for: (i) peak load: alternative gas turbine plant, and (ii) base load: alternative coal fired plant.

Table 11.6.4 Alternative Values of Capacity and Energy

Classification	Alternative	Unit capacity value	Unit energy value
Peak load supply	Thermal plant: gas turbine plant	56 USD/kW/year	6.5 US cents/kWh
Base load supply	Thermal plant: coal steam plant	144 USD/kW/year	17.4 US cents/kWh

Source: Estimated based on construction and O&M costs of thermal power plants in JAMALI.

The above method is theoretically correct. However in practice, the installed capacity of the Wonogiri hydropower station is very small and it would not be replaced if it became impossible to operate due to sedimentation of the reservoir.

The Wonogiri power station is integrated into the JAMALI system. PLN estimates that in 2005 the generation cost for additional power capacity reached 17 US cents/kWh (1,700Rp./kWh).[3] The benefit of the Wonogiri power station can be estimated based on that generation cost and average annual power generation. The benefit of the Wonogiri power station is calculated based on (i) alternative thermal plant, and (ii) additional power capacity generation cost, summarized as follows:

[1] Jawa Tengah in Figures, 2005; in 2004: number of customers in Kabupaten Wonogiri was 189,180; Central Java Province bought 9,598,867MWh.
[2] PLN and BAPPENAS, 2006 low scenarios for annual economic growth of 6.5%; total electricity demand in Indonesia will increase from 97.91TWh (2004) to 145.72TWh (2009). GoI encourages participation in Load Adjustment Contracts, Surplus Power Purchase Agreement, Integrated Resource Program, others – to ensure optimal use of all installed capacities.
[3] According to PLN; The Jakarta Post, February 9 2006

Table 11.6.5 Annual Benefit of PLTA Wonogiri

(Unit: US$ in 2005 values)

	Based on alternative thermal plant	Based on generation cost for additional power capacity
Annual benefit (US$ 000/year)	1,516	6,621

Source: JICA Study Team estimation

The annual benefit estimate based on the additional power generation cost of PLN (US$ 6.6 million) is much higher than the benefit based on an alternative thermal plant (US$ 1.5 million). The difference can be as a result of two (2) reasons: (i) for the generation of additional power capacity PLN will have to burn more oil-based fuel and oil prices keep on increasing; that is why PLN estimated the cost as high as 17 US cents/ kWh, (ii) the alternative thermal plants installed capacity is large[4], and so the unit energy value is relatively small.

The PLN estimate of the additional power generation cost of 17 US cents/kWh (1,700Rp./kWh) can be compared with the tariff levels. The electricity tariff selling price is regulated by the government. In 2004, the average tariff was about 6 US cents/kWh (Rp.555/kWh). The tariff structure does not reflect its cost[5], and it is considered below its economic value. For 2006 GOI announced an increase in electricity price of about 30%.[6]

Table 11.6.6 Electricity Tariff [US cents/kWh]

	2004	2005
Residential users	5.81 US cents/ kWh	
Commercial users	6.64 - 8.09 US cents/ kWh	
Industrial users	5.29 – 7.75 US cents/ kWh	av. 8.66 US cents/ kWh

Source: PLN
Note: 1US$=9,100Rp.

The tariff is not a good indicator for evaluating the benefit of the PLTA Wonogiri. Finally, based on the above, the annual benefit of the PLTA Wonogiri is estimated at US$ 6.6 million.

Irrigation benefit:

In preparing the economic prices for the internationally traded crops produced by the Project, it is assumed that Indonesia will continue to be a net importer of rice, maize, groundnut, and soybean, so import parity prices are used for these commodities. The economic prices of fertilizers are calculated with the expectation that Indonesia will continue to export surplus urea and import triple superphosphate and potassium chloride. The prices for other commodities, which are not traded internationally, are based on recent farm-gate prices recorded during the Project and smoothed to allow for seasonal irregularities.

[4] 280MW gas turbine plant and 800MW coal steam plant

[5] E.g. for the residential users the tariff is the lowest, even though this group mostly uses electricity during peak hours. GoI intends to calculate the "economic tariff", reflecting costs and affordability for consumers. Tariff will take into account costs of generation, transmission, distribution, losses, future investment, some return for investors (SOE, private, local governments); factors influencing tariff are: total investment capital, financial conditions, fuel costs, O&M costs, other risks (exchange rate fluctuations). GoI will still subsidize investment costs (basic infrastructure) and operational costs for targeted poor customers.

[6] For industries, electricity price can reach about 15 US cents/ kWh (1,380 Rp./kWh); industries provide 38.7% of PLN revenue

Economic prices for internationally traded commodities are based on the World Bank forecasts of projected international commodity prices for 2005, and historical prices are expressed in constant year 2005 prices. Economic farm-gate prices are derived by making appropriate adjustments to account for any quality adjustment and allowing for processing, freight, handling and distribution costs.

The annual benefits of irrigation are estimated at US$ 47.8 million, based on the following reasoning.

The water for irrigation is available all the year. The water allows for the additional production of paddy and polowijo during the dry season. That incremental production of rice and soybeans during the dry season will serve as an approximation for the benefit of the irrigation water.[7].

Table 11.6.7 Actually Irrigated Area, 1999/2000

(Unit: ha)

Category	Wet season	Dry season	Dry season
	MT I	MT II	MT III
Irrigated paddy	26,766	26,769	26,212
Sugarcane	172	255	255
Polowijo (soybeans)	211	188	625
Total	**27,149**	**27,212**	**27,092**

Source: Technical Report of Wonogiri Irrigation Project, 2000

The benefit is estimated by the production produced from the area of 100% of MT III and 50% of MT II. Tables 11.6.8 and 11.6.9 gives the financial and economic prices of agriculture inputs and outputs. Table 11.6.10 gives crop budget, concluding the financial and economic net income per hectare.

The annual economic benefit from irrigation is estimated at US$ 47.8 million per year as summarized below.

Table 11.6.11 Annual Economic Benefit of Irrigation Water

(Unit: US$ in 2005 values)

Category	Wet season MT I	Dry season MT II	Dry season MT III	Total (US$ million)
		50%	100%	
Irrigated paddy				47.7
Irrigated area (ha)		26,769	26,212	
Net income (USD/ha)		1,204	1,204	
Polowijo (soybeans)				
Irrigated area (ha)		188	625	
Net income (USD/ha)		209	209	0.1
Total		**16.1**	**31.7**	**47.8**

Source: JICA Study Team

Domestic and Industrial water benefit:

PJT I Bengawan Solo supplies annually about 3.3 m^3 million of Wonogiri dam water for domestic use and 33.5 m^3 million for industrial use (as of 2005). The demand for domestic and industrial water is expected to grow 10% annually. The customers are located in Central and Eastern Java.

[7] Data source of market prices 2005 of rice and agriculture inputs for the estimation: BPS kabupaten Sukoharjo; village administration kabupaten Sragen/ kecamatan Masaran/ desa Pringanom.

The economic benefit from domestic/industrial water supply was not quantified, since the value is negligible compared with other uses of Wonogiri dam reservoir water. However, it must be noted that the revenues from domestic and industrial users are the main financial source for PJT I Bengawan Solo, which is responsible for the operation and maintenance of the Wonogiri dam.

(3) Benefit of Watershed Conservation

Mutliple positive benefits are anticipated for agriculture from the proposed watershed conservation project in the Wonogiri watershed. The major benefits are the ones on crop sub-sector brought about through both the soil and water conservation measures and land management and agricultural promotion measures and the ones on livestock sub-sector attributed to the increase of fodder production brought about mainly by the soil and water conservation measures. In the Master Plan study, estimates have been prepared of the benefits for the crop sub-sector from the project.

i) Current Cropping Pattern (without project condition)

For the estimation of benefit, it is assumed based on the field survey that the current cropping pattern for the uplands area in the target area is used in the "without project" condition as follows: With maize cultivation, the varieties of maize are different depending on the locality. It is assumed in this study that hybrid maize varieties prevail in the uplands having slope steepness of 0-25%, while composite maize varieties prevail in the uplands having slope steepness of over 25%. This is because steep uplands do not provide the conditions required to introduce highbred maize varieties due to poor management of soil farming and terrace lands.

Table 11.6.12 Current Cropping Patterns in Uplands

Cropping Season	Cropping Pattern
1st cropping season (MT-I)	Maize* (intensity 100%) + cassava (intensity 20%)
2nd cropping season (MT-II)	Groundnut (intensity 40%) + cassava (intensity 20%)
3rd cropping season (MT-III)	Cassava (intensity 20%)

Source: JICA Study Team

ii) With Project Cropping Pattern

It is assumed that the proposed cropping patterns under the "with project" condition for the uplands are classified by 5 groups of slope steepness. The details are as shown in Table 11.6.13. After the implementation of the project, all the uplands will be equipped with improved bench terraces. Afterwards, soil erosion will be prevented from the uplands, resulting in an increase in soil fertility. The beneficiaries in the project area will be able to easily cultivate crops on the flat land. The project can provide the bases for introduction of the improved farming including improved crop varieties.

Basically the current cropping patterns in the project area will not be changed drastically. In the "with project" condition, improved varieties of seasonal crops and agro-forestry crops will be introduced. The plan is that hybrid maize varieties and improved groundnut varieties will be grown in all the uplands. The areas cultivated in cassava will be decreased and replaced with areas cultivated in agro-forestry crops. As mentioned in Section 9.3, the proposed trees and perennial/estate crops for agro-forestry development are teaks, Sonokeling, Merkusi pine, Eucalyptus, Sengon, Bamboo, Mango, Durian, Rambutan, Cashew nut, Clove, Cacao, Mlingo, Citrus and so on. The individual beneficiaries will choose the crop varieties.

It is also planned that there will be inter-cropping of maize under agro-forestry crops, which is possible up to the 4th year after the beginning of planting of agro-forestry crops. Afterward, maize could not be grown because the canopy of agro-forestry crops becomes too dense to allow sunlight at ground level.

Furthermore, medicinal crops that do not require high sunlight will be introduced as inter-cropping crops under agro-forestry croplands to increase farm incomes.

iii) Economic Benefits

Benefits from the Watershed Conservation Project area are estimated as the difference between the net return from crops in the "with project condition" and net return crops in the "without project" condition (current condition). The benefit is estimated over 15 years and afterwards is assumed to be the same as that of the 15th year. Benefits from the agro-forestry crops are calculated as the average value of 6 crops such as mango, durian, rambutan, cashew nut, clove and cacao.

Economic Benefit is estimated on the basis of border parity prices for farm inputs such as urea, TSP and KCL and the shadow price (0.75) for unskilled labor.

The total economic benefits from the Wonogiri watershed conservation project gradually increase year by year owing to the increasing profit from agro-forestry crops and are shown in Table 11.6.14. Basic data for the economic benefit such as economic crop budgets, economic benefits/ha is explained in Supporting Report II Annex No.9

Annual economic benefit is summarized below:

Table 11.6.15 Annual Economic Benefit of Watershed Conservation

Slope Classification	Benefit (Rp.million)		
	1st – 4th year	5th – 10th year	11th – 15th year
0-8%	648~857	768~1,261	1,335~1,395
8-15%	231~1,222	700~2,891	3,282~3,543
15-25%	-1,183~-187	225~3,307	3,288~4,221
25-40%	-1,013~178	624~3,362	3,596~4,174
Over 40%	-2,551~-471	892~5,541	5,498~6,918
Total Benefit	**-594~2,615**	**2,524~9,669**	**10,175~11,819**

Source: JICA Study Team

11.6.4 Economic Evaluation for the Project

(1) Assumptions

The following assumptions are applied to the economic evaluation.

Price level and exchange rate:

The analysis is done using the price level of December 2005, and applying the following exchange rates:

1 US$ = 10,035 Rp. 1 JPY = 83.9 Rp. 1 US$ = 119.6 JPY

The costs and benefits are estimated according to local conditions and expressed in US$.

Project life:

The project life is set at 100 years after implementation of all of the proposed countermeasures. For economic evaluation, the project life is assumed for 50 years after the implementation. The residual value of the facilities at the end of the project life is

neglected.

Discount rate:

A discount rate of 12% which is applied for the similar projects in Indonesia is adopted.

(2) Result of Economic Evaluation

Discount rate:

A discount rate of 12%, which has been applied to similar projects in Indonesia, is adopted.

(2) Result of Economic Evaluation

The result of evaluation for the project is expressed in IRR (%) and net present value (B-C) as given in Table 11.6.16. The economic feasibility line for the project is considered plus figure for benefit–cost (B-C) and 12% or higher for EIRR, which is based on the discount rate of 12%.

The comparison of economic costs and benefits for the Project gives an EIRR of 16.4%. That is 4.4 percentage points above the discount rate (12%), which is considered an acceptable level of rate of return for the projects in Indonesia. Therefore, the Project is considered to be highly effective.

11.6.5 Screening based on EIA System (AMDAL) in Indonesia

The structural components in the master plan are categorized by the 'Infrastructure Sector,' specifically related to 'Dam Construction' and the 'River Normalization and Canalization.' The following are the type and size of the components/actions of Dam Construction and River Normalization and Canalization requiring AMDAL stipulated in Ministerial Decree No. 17/2001.

Table 11.6.17 Type and Size of Dam Construction and River Normalization and Canalization Requiring AMDAL (stipulated in Ministerial Decree No. 17/2001)

Type of project/action	Size
Dam construction	Height > = 15 m, or Reservoir area > = 200 ha
River Normalization and Canalization	
a. Big/Metropolitan City *	Length > = 5 km or Dredging Volume >= 500,000m^3
b. Medium City *	Length > = 10 km or Dredging Volume >= 500,000m^3
c. Villages *	Length > = 15 km or Dredging Volume >= 500,000m^3

Note; Big/Metropolitan City is defined based on its area: >= 5,000 ha.
Medium City is defined based on its area: >= 1,000 ha, but < 5,000 ha.
Village is defined based on its area: < 1,000 ha.

If the project component falls under the category above table, the project proponent has to follow AMDAL when implementing the project. Otherwise, the project proponent has to develop Environmental Management Efforts (UKL) and Environmental Monitoring Efforts (UPL) depending on the possibility and magnitude of the environmental adverse impacts.

As for the proposed components in the Master Plan, only the dredging is the type/action for which it is necessary to conduct AMDAL. Accordingly, the JICA Study Team inquired of BAPPEDAL, Central Java Province, which is a competent authority on AMDAL for this Project, as to the necessity of AMDAL, or EIA Study, explaining the detailed plan including location and dimension of the project components. The answer of BAPPEDAL was that AMDAL was not required for the proposed maintenance dredging to keep the

function of Wonogiri reservoir, whose dredging volume is anticipated to be less than 100,000 m^3/year.

11.6.6 Category of the Project under JICA Guidelines

JICA provided new Guidelines for Environmental and Social Considerations in April 2004. This Study would follow the new guidelines. Details are described in the Supporting Report Annex No.8.

Based on the review result of Drafts of Scoping, JICA Study Team classified the Project as the "Category B", because of the following reasons:

i) According to the JICA Guideline, the proposed project might be categorized in the sensitive sector likely to have significant adverse impact on the environment and society. However, the proposed project is not a new development project, but a rehabilitation project.

ii) The type and/or size of the proposed project components are not such that an Environmental Impact Assessment (AMDAL) is required in Indonesia, which was confirmed by inquiry to Bappedal, Central Java Province as described above.

iii) In addition, as a result of IEE study, the evaluation shows that the proposed project components do not cause significant adverse impact on the environment and society. Thus, the proposed project is categorized as B.

11.7 Selection of Priority Project for Feasibility Study

The urgent countermeasures proposed in the Master Plan are recommended as the priority project that will be subject to the feasibility study in Phase II of the Study. The urgent countermeasures comprise:

a. Sediment storage reservoir with new gates
b. Watershed management and conservation in the Keduang River catchment
c. Procurement of dredger

11.8 Capacity for Operation and Maintenance

PJT I Bengawan Solo is responsible for the operation and maintenance of the Wonogiri dam (the responsibility was transferred by PBS in 2003). The main revenues of PJT I Bengawan Solo come at present from tariff collection for the Wonogiri dam water from: i) PLTA Wonogiri (hydropower generation), and ii) domestic and industrial users.[8] These revenues can be used to cover the O&M expenditures. The level of available revenue is summarized in the following table:

Table 11.8.1 Revenues of PJT I Bengawan Solo

Revenues	**Revenues,** [Rp.million]					
	Actual			Planned		
	2003	2004	2005	2006	2007	2008
Total	**3,282**	**5,397**	**6,101**	**6,250**	**6,905**	**8,380**
I. Water service:	2,844	3,084	4,215	5,225	6,140	7,540
Hydropower	1,361	1,062	1,507	1,968	2,190	2,500

[8] Based on the Presidential Decree No. 58 of 1999, stipulating that PJT I can charge and receive financial contribution for water resources infrastructure's O&M purposes. Government Regulation No. 6 of 1981 on Contribution for Operation and Maintenance Cost for Water Resources Infrastructure determines that beneficiaries are obliged to contribute to sustainability of water resource infrastructure. Chapter 7 of the Minister of Public Works Regulation No. 56/PRT/1991 determines the finance and tariff

Revenues	Revenues, [Rp.million]					
	Actual			Planned		
	2003	2004	2005	2006	2007	2008
Domestic	43	151	162	239	470	610
Industries	1,440	1,871	2,546	3,018	3,480	4,430
II. Non-water service:	438	2,313	1,886	1,025	765	840
Tourism					55	60
Equipment	409	2,278	1,787	950	530	580
Construction					60	70
Consultation						
Others	29	35	99	75	120	130

Source: PJT I Bengawan Solo Income Statement, January 2006, and PJT I Long Term Plan 2004-2008.

PJT I Bengawan Solo can spend less than 30% of its revenues on O&M expenditures. Table 11.8.2 gives the income statement of PJT I Bengawan Solo in detail that shows the capacity to cover the O&M costs in the future. In 2005, the O&M expenditure was about 24% of the revenue. However, up to date PJT I Bengawan Solo has only been able to cover about 4% of the O&M costs.[9] Table 11.8.2 also presents the O&M plan for the year 2006.

The possible measures to increase the sustainability for the coverage of the O&M costs would involve:

i) Changes for the tariff setting: PJT I does not set the tariffs for its customers. The Ministry of Finance sets tariffs for hydropower use and the Provincial government sets tariffs for municipal and industrial users.[10] Furthermore, irrigation water (bulk supply) is still free and brings no revenue for PJT I. The possible changes could involve imposing an irrigation service fee, contributing considerably to the financial capacity of PJT I to cover the O&M costs of the Wonogiri dam.

ii) Increased government subsidy: PJT I is a state-owned and semi-profit making corporation (*Perum*) [11]. It has to show a budget surplus to be considered a healthy corporation. The pre-established "profit" has to be paid to the central government, Ministry of Finance. PJT I has to limit the expenditure for O&M to pay that "profit". As of 2006, some employees of PJT I Bengawan Solo were paid from the central government budget.

11.9 Current Institutional Issues and Recommendations for Wonogiri Watershed Management

A number of issues and constraints are preventing the satisfactory management of Wonogiri watershed. The more important of these are summarized with remedial recommendations in the table below:

Table 11.9.1 Main Institutional Issues and Recommendations

No.	Main Issues	Recommendations
1	• Lack of law enforcement. Shown by: - Farmer encroachment in forest areas	• Bupati should establish a task force composed of all concerned government and private groups in the

[9] Approximating the annual O&M needs as 1.3% of assets' investment value (Rp. 2,886 billion in 2003) - according to experience in the Brantas River Basin and other countries

[10] Finally Ministry of Finance gives the rate by regulation; Province Governor is a President's representative.

[11] A *Perum* corporation is not supposed to make profit in the business sense, but must balance its costs and revenue budgets each year, and show a fixed return on investment.

No.	Main Issues	Recommendations
	- Illegal logging - Illegal forest burning • Little concerted action (that is, addressing all relevant factors systematically) to combat the problem	kabupaten (e.g. forestry (including KPH Surakarta for State forests), agriculture, public works, police, farmer groups, NGOs). With the approval of Central Java Governor. • The task force should develop a plan taking into account all necessary aspects and then ensure its execution. External funding to be arranged as required.
2	• Lack of emphasis on watershed management (soil management) especially in agricultural agencies. Admitted by some provincial officials.	• All vision and mission statements should state clearly the responsibility for watershed management at kabupaten, province and national levels. • Managers and staff must think more of longer term watershed conservation
3	• Lack of funds and other resources at kabupaten and , increasingly, province levels of government to fulfil their TOR and strategic plans. • Sufficient funds have not been transferred from CG to province and to kabupaten level > *otonomi daerah.* This has caused overlapping roles and lack of accountability at lower levels.	• Sufficient funds should be transferred from CG to allow adequate capacity building in the s/dinas forestry and dinas agriculture. • In addition, kabupaten and province to raise money from cost reduction (e.g. labor costs too high) and business development. Serious effort needed here.
4	• Management of watershed conservation / management has been neglected due to 3 above, but also from lack of attention to coordination of this essential task. • No one agency has overall responsibility for watershed management.	• Top down management of this area by CG bodies such as BPDAS, is no longer possible after *otonomi daerah*. • Coordination via committee at watershed and province levels seems the best compromise. Several options exist for organization of these committees: - Add watershed conservation TOR and members to the existing PPTPA and PTPA committees (soon to become WR councils under Law 7/2004) - Set up separate watershed management committees like PPTPA - Set up separate watershed management committees as sub committees of PPTPA and PTPA. <u>Advantages of 1)</u> • Integration of WRM and watershed management • Quicker to establish as WRM committees already exist <u>Disadvantage of 1)</u> • Watershed management could be sidelined as most attention on WRM • Note that options 2) and 3) need more administrative effort and member time. <u>Pilot Implementation in Wonogiri Watershed</u> • A pilot watershed conservation coordination committee (WCCC or WC3) should be set up immediately for the Wonogiri watershed, in order to: - Coordinate all aspects of watershed management (planning, implementation, evaluation; on-farm & off-farm) • WC3 members would include representatives from Wonogiri and Pacitan governments and other agencies, e.g.: - BAPPEDA; BPDAS Solo; Kabupaten Forestry, Agriculture and Environment Services; Perum Perhutani (KPH Surakarta); PJT I Bengawan Solo; Balai PSDA; and stakeholders: - Major landowners; farmer group representatives; community representatives; PLN; local NGO; a University (Gadja Mada);

No.	Main Issues	Recommendations
		• Wonogiri WC3 could later expand to cover all the Upper Solo watershed like PPTPA Solo, as follows: - by adding WM functions and members to PPTPA, or - by forming a separate WM committee (an expansion of Wonogiri WC3, or - by forming a separate WM subcommittee attached to PPTPA.
5	Concerning the management of State forests by Perum Perhutani: • Current poor condition of some areas of KPH Surakarta reported by various sources (e.g. less than 11% currently forested says S/dinas Forest Wonogiri. Should be up to 30%) • Vision and mission statements of Perum Perhutani do not mention watershed conservation and protection • Highly probable that too little attention given to this aspect of forest management	• Perum Perhutani (i.e. KPH Surakarta) should be regulated on Central Government's behalf by a suitably qualified and experienced agency. BPDAS is suggested because: - It is a already assisting the planning and monitoring of non-State forests - Watershed management is its main and specific remit - It reports to Ministry of Forestry (DG Land Rehabilitation and Social Forestry) - It was set up as a planning, monitoring and evaluation agency. • It would be beneficial to bring all forested areas under the supervision of one agency.
6	• There have been many complaints by managers at kabupaten and province levels of staff lacking adequate training	• All managers – especially in Kabupaten Forestry and Agriculture – should formally review the competence and level of training of each member of their staff against what is needed (this is Training Needs Analysis). • Determine training needed and ensure it is provided soonest. Prioritize according to greatest benefit.
7	• Sub Dinas Forestry is the most important unit in Dinas LHKP (environment and mining services are the other two) • Past lack of emphasis on watershed management must be corrected	• Sub Dinas Forestry should be upgraded to a full Dinas as soon as possible because: - This would give proper emphasis to forestry and watershed management compared to agriculture (out of total area of 182,000 ha, some 51,000 ha is estimated to be either critical or moderately critical) - This unit will need to grow significantly to undertake the workload needed (eg to increase the forested areas from 11% towards 30% in the kabupaten)
8	• Sub Dinas Forestry is under staffed, under equipped and under funded to handle its workload	• Field staff should be doubled to 120 to cover the work needed in its areas of forest development, production, industrial processes and community development. Additional staff would be concentrated in the following river catchments: - Keduang, Tirtomoyo, Temon, Upper Solo. • Also field staff in particular require more training so that they need less supervision. • More office equipment is needed especially for mapping and surveying • Budgets under funded by up to 60% (Rp.484 million in 2005) should be topped up.
9	• Dinas Agriculture is under staffed, under equipped and under funded to handle its workload. Some of this shortfall will adversely affect the improvement of watershed management.	• At least 40 extra field staff (PPLs) are needed to service 294 villages giving a total of 118+40=158 persons. (Ideally, the ratio should be one PPL per village) • Refresher training is needed for all field staff. • 10 computers (to replace old ones), a rainfall gauge and ubinan equipment are also needed. • Only 41% of the 2005 planned expenditure could be funded, with especially large shortfalls in Public Services (more than 70%). To fully fund the planned Wonogiri budget for this dinas would require an additional Rp.15 billion.

No.	Main Issues	Recommendations
	• Absence of Cabang Dinas giving Extension Coordinators too much to do (administration + field supervision).	• Re absence of Cabang Dinas: one or more kecamatan staff should be educated / trained to handle some of the administrative workload supervised by Extension Coordinator and Camat.

Source: JICA Study Team

Comments on major issues are as follows:

(i) Lack of law enforcement is the biggest issue concerning watershed management. This is a problem partly of weak political will at every level, partly of poor definition of authorities. If laws are not properly enforced, the whole legal system is brought into disrepute. Now, under a new administration the laws and regulations governing watershed management should be progressively and continuously applied, with severe penalties for senior officials who do not comply.

(ii) Many organizations are concerned with WM, some with apparently overlapping mandates. The exact boundaries of each organization's remit are not clearly defined *in practice*. Part of the problem here is the lack of resources apparently available at kabupaten and, increasingly, province levels. Generally, inadequate resources have been transferred from central (in particular) and provincial governments to local government post *otonomi daerah (OD)* to cope with the workload increase arising from decentralization. In some cases, provincial funding is being severely cut back (e.g. Forestry and Agriculture Services).

(iii) Under OD, the removal of any effective control link between provincial agencies and kabupaten / kota has made the current management of local government more problematic. It remains to be seen whether this experiment in governance eventually yields the desired results.