Annex No.9 Watershed Conservation and Management

THE STUDY ON
COUNTERMEASURES FOR SEDIMENTATION
IN
THE WONOGIRI MULTIPURPOSE DAM RESERVOIR
IN
THE REPUBLIC OF INDONESIA

FINAL REPORT

SUPPORTING REPORT

Annex No.9: WATERSHED CONSERVATION AND MANAGEMENT

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CHAPTER 1 PRESENT CONDITIONS

1.1 Soils, Topography and Land Use

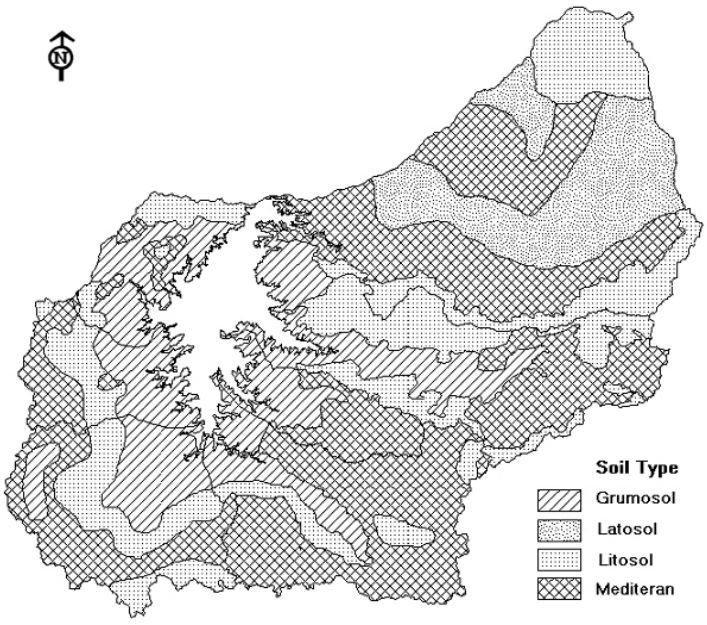
1.1.1 Soils

The present soil study has been made based on the soil maps (scale: 1/25,000) prepared by SBRLKT, Solo in 1985, the reconnaissance map (1/250,000) prepared by the Soil Research Institute, Bogor in 1973, an existing document[1] and field reconnaissance survey. The SBRLKT's maps were prepared on the basis of the map prepared by the Institute and field investigations. However, general chemical and physical properties of soils are not presented in both the maps and kinds of information on the soils in the Wonogiri watershed are rather limited.

The soils distributed in the Wonogiri watershed are classified following the old Indonesian classification system, into four soil types of *Mediteran* (Soil Taxonomy: Alfisols), *Litosol* (Inceptisols), *Latosol* (Alfisols) and *Grumusol* (Vertisols) as shown in Figure 1.1.1. The distribution of the soils in the Wonogiri watershed are shown in Table 1.1.1 and summarized below.

Table 1.1.2 Soil Distribution in Wonogiri Watershed

Soil Type	Distribution	
	(ha)	(%)
Mediteran (Alfisols)	52,461	42
Litosol (Inceptisols)	31,070	25
Grumusol (Vertisols)	26,091	21
Latosol (Alfisols)	14,861	12
Total	124,483	100



Source: soil map (1/25,000) prepared by SBRLKT, Solo 1985

Figure 1.1.1 Soil Map of Wonogiri Catchment Area

[1] UWSPP consultant report; Consulting Services for the Upper Solo Watershed Protection Project, Soil & Water Conservation, BCEOM, 1991

Major characteristics of the soils distributed in the Wonogiri watershed are explained as follows;

(1) Mediteran

The soils are distributed in moderate to steep sloping areas in the entire Wonogiri watershed and their distributions account for 52,461 ha or 42% of the Wonogiri watershed.

The soils are highly weathered and have weak cohesion capacity because of leaching out of cementing materials as base, organic matter and silica. Accordingly, the soils are susceptible to water erosion and control of erosion in areas distributed with the soils could be difficult. Particle sizes of clay minerals are larger than those of *Grumsol* and the soils are porous with a smaller specific surface area. Erosion types found in these soils are gully erosion, collapse of slope and land slides. The soils usually have deep solum.

The soils are fine textured (clay to silty clay according to the field observation) and are sticky to very sticky in stickiness.

(2) Lithosols

The soils are distributed in areas with hilly to mountainous terrains and found in all sub-basins except for the Temon Sub-basin. The area extent is 31,070 ha or 25% of the Wonogiri watershed.

The soils generally have shallow or very shallow solum depth underlain by bed rocks or unconsolidated materials of volcanic origins. Outcrops of rocks are observed in most parts of the areas distributed with the soils. The soils are mostly distributed on steep slopes and quite susceptible to erosion. Soil conservation measures including vegetative and physical ones are essential for the control of erosion in areas distributed with the soils. Further losses of surface soils will bring about serious degradation of lands distributed with the soils.

The soils are fine textured with coarse fragments (sandy clay to sandy silty clay) and slightly sticky to sticky in stickiness.

(3) Grumusol

The soils are distributed in flat to slightly sloping lowland areas around the Wonogiri Reservoir and along the Solo and Tirtomoyo Rivers for the extent of 26,091 ha or 21% of the Wonogiri watershed. Clay particles of the soils are easily dispersed by rain drops and dominant clay mineral (montmorilonite) has a high shrinkage and swelling rate. The infiltration of the soils is very low and erosion types in the soils are splash and sheet erosion. The solum depth of the soils is moderate to deep depending on locations.

The soils are fine textured (clay to silty clay) and are sticky to very sticky in stickiness.

(4) Latosol

The soils are exclusively distributed in moderate to steep sloping areas in the Keduang Sub-basin and occupy 14,861 ha or 12% of the Wonogiri watershed.

The soils have similar characteristics to *Mediteran* and are highly weathered and have weak cohesion capacity. Accordingly, the soils are susceptible to water erosion and control of erosion in areas distributed with the soils could be difficult. The soils are friable and porous with a smaller specific surface area. Erosion types found in these soils are gully erosion, collapse of slope and land slides as well as the case in *Mediteran*. The

solum depth of the soils is deep in general.

The soils are fine textured (clay to silty clay) and are very sticky in stickness.

1.1.2 Topography

It is featured that the Wonogiri watershed is composed of steep lands. Furthermore the lands are deeply dissected by the small tributaries in the watershed. The features of steepness in sub-basin are shown below:

Table 1.1.3 Features of Steepness in Wonogiri Sub-watersheds

Name of sub-basin	Proportional % of the area classified steepness				
	Slope steepness (%)				
	0-3	3-8	8-15	15-25	Over 25
Keduang	21	26	20	11	22
Tirtomoyo	13	9	10	15	53
Temon	33	19	14	10	24
Upper Solo	21	11	12	16	40
Alang	44	17	12	10	17
Ngungganhan	32	13	14	15	26
Wuryantoro	26	27	21	12	14
Entire area	24	18	15	13	30

Source: JICA Study Team

Land having steepness of over 25% occupies about 30% of the total catchment area, especially Tirtomoyo and Upper Solo basins are steep.

1.1.3 Land Use

(1) Methodology

The survey was conducted by using the land use map (1/25,000) prepared by BAKOSURTANAL as a base map, and the topographic map (1/25,000) and air photographs produced from Spot Satellite images (1/25,000) as field maps. The field survey was carried out for confirmation of land use. The delineation of the state forest was made based on the maps prepared by BP DAS Solo and Surakarta Administration Unit (KPH Surakarta) of the State Forest Corporation. The land use status of the state forest was investigated by interpreting the satellite images taken in 2003.

(2) Present Land Use

In the present Study, the land uses in the Wonogiri watershed have been classified into land use categories of: i) paddy field, ii) home settlement, iii) upland field, iv) orchard/plantation, v) forest, vi) state forest, and vii) others. Among the categories, paddy field occupies the largest share followed by upland field and home settlement. The upland field and parts of home settlement areas are extensively used for dry land farming. The share of forest area (forest, orchard and plantation) is rather limited in the Wonogiri watershed. The present land use of the Wonogiri watershed is shown in Figure 1.1.2 and summarized below.

Table 1.1.4 Present Land Use in Wonogiri Watershed

Land use	Area (ha)	Ratio (%)
(1) Paddy field	30,495	24.5
(2) Home Settlement Area	26,764	21.6
- Housing yard and garden	7,289	5.9
- Uplands in Settlement Area	19,475	15.7
(3) Upland field	39,761	32.0
(4) Orchard/ Plantation	12,867	10.3
(5) Forest	281	0.2
(6) State forest	12,779	10.3
- Forest	385	0.3
- Other land use	12,394	10.0
(7) Others	1,384	1.1
Total	124,331	100.0

Source: Results of JICA field survey and interpretation of Satellite image, and data of BAKOSURTANAL

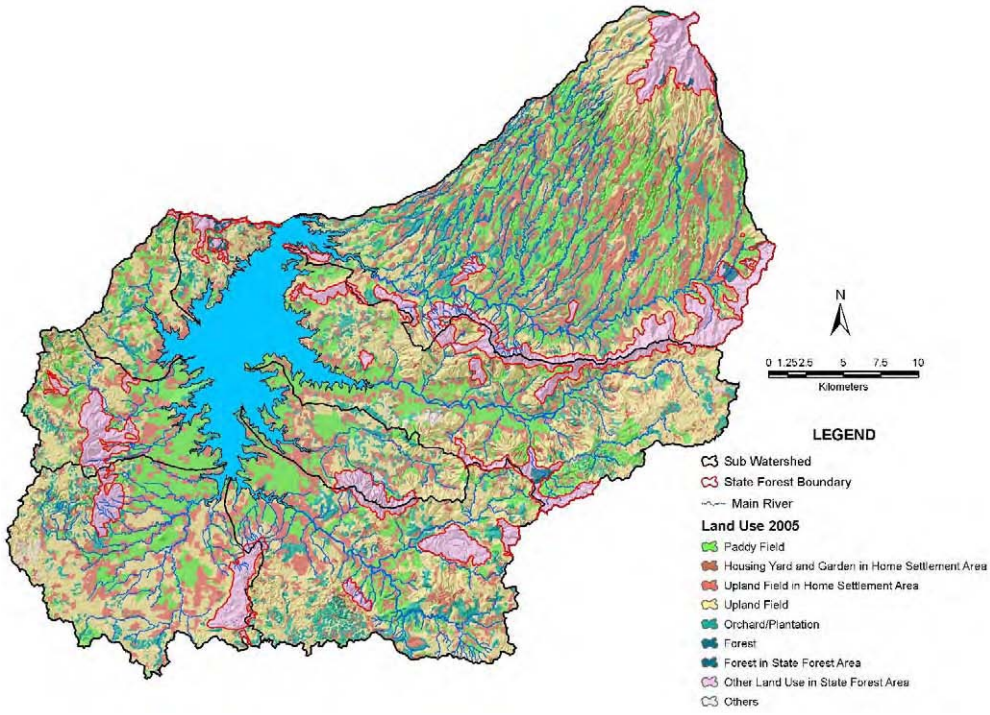


Figure 1.1.2 Land Use Map in the Wonogiri Watershed

Brief explanation of individual land use categories are as follows;

Paddy Field (*sawah*)

This land use category consists of irrigated paddy field and rainfed paddy field. Lands of this category are mainly distributed in moderately to steeply sloping areas of Keduang Sub-basin and in low-lying areas such as areas around the southern part of Wonogiri Reservoir and along the Tirtomoyo River. Paddy fields developed in steeply sloping areas are neatly terraced to form rice terraces. Irrigated paddy fields are commonly used for double cropping of paddy, while in rainfed paddy fields single cropping of paddy is prevailing because of water constraint.

Upland Field (tegalang/ ladang)

This category of land extends in the whole Wonogiri watershed. Lands under this category are mostly bench-terraced with different protection measures and maintenance and intensively used in an agro-forestry system (tumpansari) for seasonal and perennial crops (fruits and estate crops) production under rainfed conditions. While, limited extent of lands under this category are ridge-terraced or used without terrace construction. Farming system predominantly adapted in this category of land is multi-cropping system in which plural crops are planted at the same time in a field in the 1st cropping season (October/November to January/February). However, crop production in the 2nd cropping season (February/March-May/June) is restricted by rainfall distribution. In the 3rd cropping season (June/July-September/October), practically no seasonal crops are newly planted.

Perennial crops are mostly planted under an agro-forestry system (tumpansari) with seasonal crops in this land use category, but their densities vary to a substantial extent depending on fields.

Home Settlement (pumukiman)

Lands under this category include housing yards and surrounding home gardens which are used intensively for agricultural purposes and provide an important source of farm income. Home gardens are commonly planted with a variety of crops including vegetables, palawija, fruit trees such as mango, banana, rambutan and papaya and even estate crops such as coconut, clove, cashew nut, cacao and melinjo.

Forest and Plantation (hutan and kebun/perkebunan)

This category of land in the Wonogiri watershed practically consists of state forests under the management of Perum Perhutani (State Forestry Company), peoples forests (hutan rakyat) and tree crops planted areas (orchard, kebun), since the areas covered with pure stands of estate crops (perkebunan) are limited in the Wonogiri watershed. The state forests are classified into the protected forests and production forests. The protected forests are established in the piedmont areas of Mt. Lawu. The production forests are mostly developed in hilly to mountainous areas. Major trees planted in the forests are merkusi pine (Pinus merksi), sonokeling (Darbegia grandis), teakwood (Tectona grandis), mahogany (Swietenia machopylia) and Eucalyptus (Eucalyptus degluputa).

In the peoples forests, similar kinds of trees to the state forests except for merkusi pine and various kinds of fruits trees are planted, although a teakwood is a dominant tree. The forests are used under an agro-forestry system (tumpansari) and crops tolerant or suitable for shade such as medical crops (ginger and turmeric) are intercropped beneath the canopies of trees.

Others

Water surface (Wonogiri Reservoir and others), grass land, bush and other land uses are included in this category.

1.1.4 Terrace Conditions

(1) Methodology

Based on the field investigations on the terrace conditions, the cropping patterns in the dry farm land are worked out by broadly classifying terraces into the following 9 types.

Table 1.1.5 Classification of Terrace Types

Terrace Type	Code		
	Terrace Width		
	< 2m	2 - 5m	> 5m
Bench Terrace (B)	B1	B2	B3
Ridge Terrace (R)	R	-	-
Traditional Terrace (T)	T1	T2	T3
No-terrace (N)	N	-	-
Composite (M) 1/	M	-	-

Note: 1/ ; Land of composite condition of ridge terrace and no-terrace

Further, the classifications of individual terraces are made applying the criteria on terrace height, with/without terrace lip, terrace lip vegetative cover, riser protection and prevailing cropping patterns, adapted on the basis of the findings on the prevailing terrace conditions in the watershed, as shown in the following table.

Table 1.1.6 Criteria for Classification of Terrace Conditions

Criteria	Classification Criteria and Code		
Terrace Height	< 1 m (H1)	1 - 1.5 m (H2)	1.5 - 2 m (H3)
Terrace Lip	with lip (L1)	without lip (L2)	-
Lip Vegetation	With grass (G1)	without grass (G2)	-
Riser Protection	With stone (S1)	without stone (S2)	-

The individual terrace conditions are classified according to the above criteria.

(2) Terrace Conditions of Dry Farm Land

The field investigations were carried out by using the topographic map of 1/25,000 and a land area with similar terrace conditions was delineated into the same mapping unit. The investigation was conducted for 494 sites of the dry farmland categorized as upland field in the present land use. The distribution of terrace types in the Wonogiri watershed is illustrated in Figure 1.1.3 and summarized below.

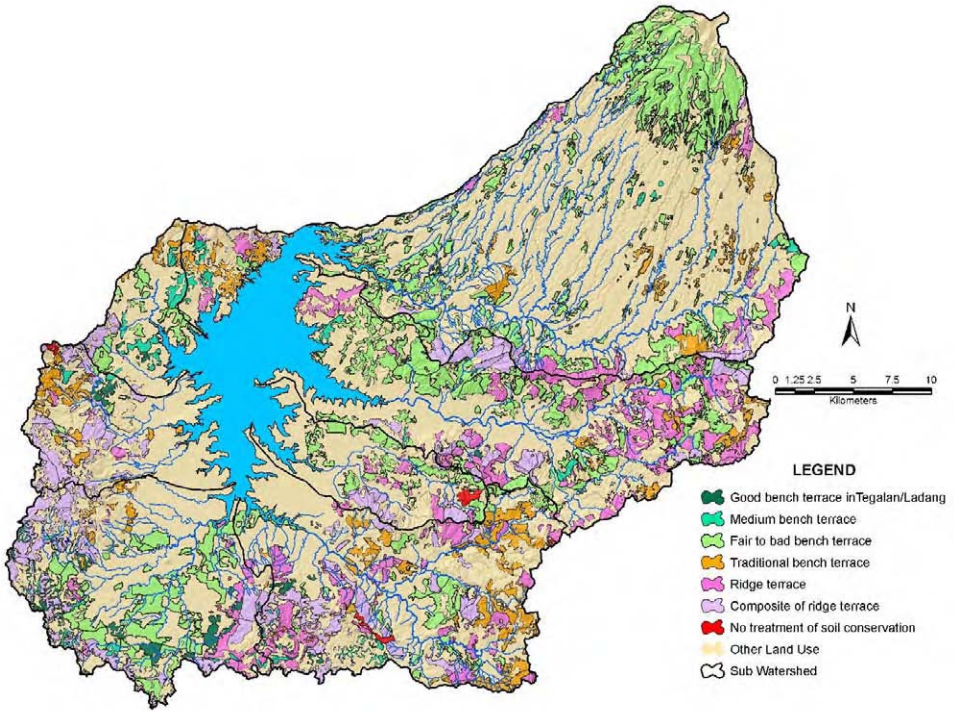


Figure 1.1.3 Terrace Condition in Upstream Field in Wonogiri Watershed

Table 1.1.7 Distribution of Terrace Types by Sub-Basin

(Unit: %)

Sub-basin	Bench	Traditional	Ridge	No-terrace	Composite	Steepness over 25%*
Keduang	73	8	11	9	0	22
Tirtomoyo	44	5	36	14	0	53
Temon	48	0	16	31	5	24
Upper Solo	23	26	25	24	1	40
Alang	54	4	9	34	0	17
Nguggahan	14	22	4	59	1	26
Wuryantoro	65	12	0	22	0	14
Remnant	25	42	22	11	0	-
Wonogiri Watershed (%)	48	11	19	21	1	

*: Ratio (%) of area with slope over 25% in each sub-basin
Source: JICA Study Team

In the Wonogiri watershed, about half of the total upland fields are installed by bench terrace. The ratios in the sub-basins vary from 73% in the Keduang Sub-basin to 14% the Nguggahan Sub-basin. Topographically, the Tirtomoyo and Upper Solo Sub-basins are classified into the steepest area as shown in the above table. However, bench terrace areas in those basins are small and development of terrace is in backwardness in the Wonogiri watershed. Furthermore, the areas with poor installation of terrace accord to the extension of the critical areas for soil erosion in the upper reaches of those sub-basins that is very high in steepness.

The proportional extent of no-terrace upland field in the Temon, Alang and Nguggahan Sub-basins is higher, because these basins have a high portion of flat lands.

Bench terrace management or maintenance status is classified based on the essential criteria of formation of terrace lip (with or without), lip vegetation and riser protection

(protected by stone or grass) as shown below:

Table 1.1.8 Criteria for Classification of Bench and Traditional Terraces

Terrace Status	Lip	Lip Vegetation	Riser Protection
Well Maintained Terrace	with complete lip	with grass	with stone or grass
Maintained Terrace	without incomplete lip	with grass partly grown or without grass	without stone nor grass
Poorly or not Maintained Terrace	Without lip	With partly grown or without grass	without stone nor grass

Source: JICA Study Team

By applying the said essential criteria, the bench terraces in the watershed are categorized into the three (3) statuses of i) well maintained, ii) maintained and iii) Poorly or not maintained and summarized in the following table.

Table 1.1.9 Classification of Bench Terrace by Sub-Basin

Sub-basin	Well Maintained		Maintained		Poorly or not Maintained		Total	
	ha	%	ha	%	ha	%	ha	%
Keduang	0	0	198	2	8,857	98	9,055	100
Tirtomoyo	17	-	211	4	4,694	96	4,922	100
Temon	0	0	0		1,106	100	1,106	100
Upper Solo	133	7	272	14	1,501	79	1,906	100
Alang	641	15	338	8	3,258	77	4,237	100
Wuryantoro	41	4	469	41	637	55	1,147	100
Remnant	0	0	212	63	123	37	335	100
Wonogiri Watershed	832	4	1,700	7	20,176	89	22,708	100

Source: JICA Study Team

Most of the terraces are categorized into poorly maintained or not maintained. The improvement of such terraces will be essential for the conservation of the Wonogiri watershed. The typical terraces are shown in the PHOTO-BOOK.

1.2 Agriculture

1.2.1 General

The agriculture sector is the largest economic sector in Wonogiri Kabupaten and the sector contributed about 52% of the district GRDP in 2002. Within the sector, the food crop sub-sector is a leading sub-sector accounting for about 85% of the sector GRDP, followed by the estate crop sub-sector of 10%, livestock sub-sector of 4%, and fisheries sub-sector of 1%. (Source: PDRB, Wonogiri, 2003, BPS)

1.2.2 Crop Sub-Sector

(1) Overall Features

The crop sub-sector's agricultural activities in the Wonogiri watershed are characterized by paddy (wet land farming) food, crops and upland (dry land farming) food, horticulture and estate crops. Wet land farming is practiced in paddy fields covering in low-lying areas and in rice terraces constructed on sloping lands. The dry land farming is extensively practiced in terraced fields constructed on moderate to steep sloping lands. The primary crop in the wet land is paddy (wet land rice), while in the dry land farming, diversified seasonal crops and perennial crops are produced. The crop sub-sector activities concerned

with the present Study are the dry land farming practiced for production of seasonal and tree crops.

(2) Wet Land Farming

Paddy production is by far the most important farming activity in the wet land farming. However, palawija production in rotation with paddy is also intensively practiced in off-season(s) or season(s) restricted from water availability. Wet land farming is carried out in irrigated and rainfed paddy fields. According to the statistic figure of BPS Wonogiri, the area extents of paddy fields in 2003 in the kecamatans located in the Wonogiri watershed (the project kecamatans)[2] are estimated at irrigated paddy field of 20,370 ha (74%), rainfed paddy field of 7,130 ha (26%) and 27,500 ha in total[3].

1) Cropping Schedules and Patterns

The basic cropping seasons of paddy fields in the project kecamatans consist of 3 seasons of MT I (*musim tana*m I, cropping season I), MT II (cropping season II) and MT III (cropping season III). MT I is from October to January and starts with the commencement of the wet season. MT II is from February to May; from the peak of wet season to the beginning of the dry season. MT III falls in the dry season from June to September. Primary crops cultivated in paddy fields are paddy (wet land rice), soybeans, maize and groundnut. In most cases, Palawija crops in rainfed fields are grown under a multiple cropping system as shown in Figure 2.5.1.

Constrained by the availability of water, both irrigation water supply and rainfall distribution, cropping patterns in the kecamatans are diversified as illustrated in Figure 1.2.1.

2) Cropping Intensity

Intensive uses of both irrigated and rainfed paddy fields have been performed by diligent farmers by availing water sources in the project kecamatans. Cropping intensities in Kabupaten Wonogiri are estimated by the Kabupaten Agriculture Services Office based on the monitoring records on monthly planted area by land use category as shown in Table 1.2.1 and summarized below:

Table 1.2.2 Annual Cropping Intensities in Paddy Fields in 2003

Category	Annual Cropping Intensity (%)		
	Paddy	Palawija	Overall
Irrigated Field	172	79	251
Rainfed Field	103	93	196
Overall	155	82	237

As shown in the tables, it could be assessed that the paddy fields in the kabupaten are utilized by availing limited water resources to a possible extent.

(3) Dry Land Farming

1) General Features

Upland field (*tegal*), home yard area (*pekaranggan*) and limited extent of orchard area, where wide range of farming operations are practiced under rainfed conditions (dry land farming), are defined as dry farmland in the present Study. The extent of

[2] Kecamatans belonging to Wonogiri Kabupaten located in the DAS Wonogiri
[3] Wonogiri in Figures, 2003, BPS Wonogiri

the land in the project kecamatans in 2003 is estimated at 80,140 ha or 74% of farm land of 107,640 ha (dry farmland + wet farmland/paddy field) based on the BPS statistic figures. Dry land farming can be characterized with its instability and is extensively practiced in the entire Wonogiri watershed because of limitation in wet land (paddy field) where wet land farming ensuring more stable farming activities is operated. The dry farmlands in the Wonogiri watershed were developed through deforestation dictated by the population pressure in the past and currently terraces of different protection measures and maintenance conditions are constructed almost in the entire dry farmlands.

The distributions of dry farmlands in the Wonogiri watershed are generally consistent with physiographic conditions of areas, except for areas developed for rice terraces, and the lands distribute extensively in moderate to steep upper reaches of watersheds, where lands are scarcely blessed with water resources for irrigation, and land resources are exposed to danger of water erosion if sufficient vegetative covers are not provided.

Use of dry farmland under multi-cropping system (tumpansari; sort of agro-forestry) composed of plural seasonal crops and perennial crops of varied densities is almost of exclusive (prevailing) farming system in the Wonogiri watershed, while monoculture system of seasonal crops (mainly maize) is also practiced to a limited extent. Tree crops are generally planted as components of the multi-cropping system and monoculture of the same is seldom recognized. Therefore, accurate features on tree crops planted areas appear to be almost impossible to estimate.

2) Cropping Schedules and Patterns

Cropping season in the dry farmland commences with the on-set of wet season in October/November, while the start of the season varies annually to some extent depending on rainfall distribution in a year. However, the prevailing cropping seasons in the farmland could be defined into the following three (3) cropping seasons:

Table 1.2.3 Prevailing Cropping Schedule in Wonogiri Watershed

Cropping Season	Period	Remarks
1st Season (MT I)	Mid. Oct./Mid. Nov. ~ Mid. Jan./Mid. Feb.	Start with wet season
2nd Season (MT II)	Mid. Jan./Mid. Feb. ~ Mid. April/Mid. May	Minimum tillage
3rd Season (MT III)	Mid. April/Mid. May ~ Mid. July/Mid. Aug.	Very limited extent

Because of the adaptation of multi-cropping system and cultivation of varieties of crops, cropping patterns in the Wonogiri watershed are multitude.

Cropping patterns in the Wonogiri watershed have been estimated based on the questionnaire survey made to the Extension Coordinators of individual project kecamatans and findings of field surveys in the present Study. The results are presented in Figure 1.2.2. Based on the same and BPS statistical data on monthly planted areas in dry farmland, the prevailing cropping patterns in the area could be generalized as shown in Figure 1.2.3and described below.

- In dry farmland, multiple cropping of seasonal crops is a cropping system almost exclusively practiced in MT I, while monoculture of maize is also practiced to a limited extent,

- Primary crops in MT I are maize, cassava, upland rice, groundnut and soybeans, those in MT II are groundnut, soybeans and maize, and the same in MT III are maize, groundnut and sorghum,
- In nearly 90% of dry farmland, cassava at different densities is planted as an association crop with seasonal crop(s),
- Isolated hills of cassava remain in farm land in MT II with or without seasonal crops and in MT III cassava is practically only crop left in the land,
- In the eastern part of the Wonogiri watershed or the Keduang Sub-basin, monoculture of maize or multiple cropping of maize with very limited population of cassava is commonly practiced,
- Scale of cultivation of vegetables in dry farmland is still limited and mainly for home consumption purposes,
- Prevailing cropping patterns in the Wonogiri watershed are:

Table 1.2.4 Prevailing Cropping Patterns in the Wonogiri Watershed

Type	Pattern
Pattern 1	MT I: seasonal crop(s) + limited density of cassava; MT II and III: limited density of cassava
Pattern 2	MT I: seasonal crops + limited density of cassava; MT II: seasonal crops (beans) + limited density of cassava; MT III: cassava
Pattern 3	MT I: Maize with very limited density of cassava; MT II: seasonal crops (beans) or fallow + very limited density of cassava; MT III: cassava

- Primary crops of typical multiple cropping systems in MT I are:
  Maize + beans + cassava: beans > or >> maize >> cassava
  Maize + upland rice + cassava: upland rice > or >> maize >> cassava

3) Cropping Intensity

Cropping intensities in dry farmland in the project kecamatans have been estimated based on the BPS statistical data on monthly planted areas in 2003 and 2004 as shown in Table 1.2.5. The results are summarized below.

- Overall seasonal cropping intensity of dry farmland is estimated at 100% in MT I, 40% in MT II (not including cassava planted area) and 1% in MT III (not including cassava planted area); achieving the improved annual intensity of 141% compared to the estimation of 120% made by the Consultant for USWPP in 1991,
- Cropping intensity in MT II varies depending on kecamatans from 9% to 94% and 40% on average,
- Cropping intensity in MT II is influenced by rainfall distribution in February/March and becomes low in years suffered from drought, and
- Basically no crops are newly planted in MT III except in Kecamatan Wuryantoro, where supplemental water is supplied by pumping from the Wonogiri Reservoir or small rivers and cropping intensity in the season is estimated at 26%.

4) Farming Practices

Prevailing farming practices in multiple cropping systems in the Wonogiri watershed are shown in Table 1.2.6 and briefly explained as follow;

Land Preparation

Land preparation in terraced dry farmland is practiced manually before the on-set of wet season.

Planting

Drill planting in line is usually practiced for maize. Initially maize is planted first and other crops such as beans or upland rice are planted after germination of maize between maize rows. Beans and upland rice are drilled at random or in line. Cassava is planted firstly or after planting of other crops.

Variety

In case of maize, use of hybrid varieties is common. While, uses of self-multiplying of seed from hybrid seed are also practiced. In other crops, self-multiplied seeds or planting material are prevailing practices. Common varieties are: maize-PC and Pioneer; upland rice - local variety; groundnut-kidang; soybeans-lokon and wilis; cassava-local variety.

Fertilization

Fertilizer application is practiced before planting or after germination of crops. Top dressing is common practices. Urea and TSP are common fertilizers applied and use of KCl is limited. Compost is rarely applied.

Weeding

Manual weeding is practiced during the initial stage of crop growth.

Harvesting and Post-harvesting

Harvesting is manually practiced and products are generally sun-dried at home garden. After drying, production surpluses are marketed after or without shelling/milling to village level collectors in case of grains and beans. Cassava tube is stored for family consumption or marketing after cutting and sun drying.

(4) Crop Productions

1) Seasonal Crops

Statistic data on overall annual harvested areas and productions of food crops grown in wet and dry farmland in the project kecamatans from 2001 to 2003 are presented in Table 1.2.7. The production features of food crops are summarized below:

Table 1.2.8 Production Features of Major Crops in Project Kecamatans (average of 2001 to 2003)

Crop	Cropped Area (ha)	Production (t)	Crop	Cropped Area (ha)	Production (t)
Paddy	34,100	184,900	Soybeans	24,600	28,100
Upland Rice	13,140	38,740	Cassava	57,800	822,000
Maize	57,600	241,700	Sorghum	3,100	2,110
Groundnut	37,100	40,800	Long Beans	280	880

Note: Rounded figures
Source: Wonogiri in Figures, 2001, 2002 and 2003, BPS

As shown in the tables, a primary crop except for cassava in the kecamatans is maize, followed by rice, groundnut and soybeans. The production of maize, groundnut and soybeans is carried out both in wet and dry farmland. While, cassava

and upland rice production is almost exclusively practiced in dry farmlands. Yield levels of crops are: paddy 5.4t/ha, upland rice 2.9 t/ha, maize 4.2t/ha, groundnut 1.1t/ha, soybeans 1.1t/ha and cassava 14.2t/ha. Stagnant productivities of beans are regarded as one main constraint for improvement of dry land farming in the areas.

2) Horticulture and Estate Crops

As stated earlier, accurate features on perennial crops planted areas appear to be almost impossible to estimate. Major horticulture crops include mango, melinjo (Gnetum gnemon), rambutan and papaya and major estate crops are cashew nut, clove, cacao and Janggelan. The production features of horticulture and estate crops in 2003, reported by BPS Wonogiri, are shown in Table 1.2.9 and summarized below:

Table 1.2.10 Production Features of Horticulture and Perennial Crops in the Project Kecamatans in 2003

Crop	Cropped Area (ha)	Production (t)	Crop	Production (t)
Chili (in 2002)	1,106	1,592	Clove	880
Long Beans	277	880	Cacao	149
Cashew Nut	-	11,219	Janggelan	6,614

Source: Wonogiri in Figures, 2002 and 2003, BPS

Production of medical crops is still limited (346 ha and 1,036 t), but the crops are listed as promising crops by the Kabupaten Agricultural Services Office.

3) Food Balances

According to the estimate on balances of productions and requirements of food crops by the Services Office, surpluses of all major crops as a whole in the kabupaten are reported as shown in Table 1.2.11. However, by kecamatan-wisely, 9 kecamatans (as Wonogiri, Ngadirijo, Jatisrono and Jatisrono) out of 20 project kecamatans indicate production shortages of rice to estimated requirements. The food balance status of the project kecamatans is summarized in the following table.

Table 1.2.12 Balances of Productions and Requirements of Food Crops in the Project Kecamatans

Commodity	Rice	Maize	Soybeans	Groundnut	Cassava
Balance	+ 2,100 t	+ 132,000 t	+ 7,400 t	+ 33,200 t	+ 219,000 t

Source: Agriculture Services Office, Wonogiri

1.2.3 Livestock and Inland Fishery Sub-Sector

(1) Livestock

The sub-sector accounts for only about 4% of the agriculture sector GRDP in Kabupaten Wonogiri (2003). However, livestock activities are reported to be providing important income sources for farm economy in the project kecamatans, especially for the same of dry land farmers.

The statistic information on livestock population in 1994 and 2004 indicates substantial increase of cattle in the project kecamatans as shown in Table 1.2.13 and summarized below:

Table 1.2.14 Changes in Animal and Fowl Population in Project Kecamatans 1/

Year	Cattle/Cow		Goat		Fowls	
	No.	%	No.	%	No.	%
1983	67,900	100	293,500	100	891,000	100
2003	121,200	178	362,900	124	1,816,000	204

Note: 1/ ; The number of livestock is Rounded figures,
Source: Wonogiri in Figures, 1983 and 2003, BPS

On the basis of the population figures, the increase of holding sizes of livestock per farm household from 1883 to 2003 in the project kecamatans are estimated as shown below:

Table 1.2.15 Increase of Holding Sizes of Animals and Fowls in Project Kecamatans

Livestock	1983	2003	Increase	Central Java (2002)
Cattle/Cow	0.4	0.7	0.3	1.6
Goat	1.3	2.2	1.1	3.2
Fowls	5.6	10.9	5.3	-

As shown in the above table, the average ownerships of livestock in the kecamatans increased, but holding sizes per farm is far less than those of Central Java Province. Farmers basically raise livestock not for commercial purpose, but as saving or assets and fowls for family consumption. The productions of livestock are estimated as follows:

Table 1.2.16 Production of Livestock in the Kabupaten in 2002

Meat Production (tons)				Egg Production
Cattle	Goat	Sheep	Fowls	(million pieces)
3,029	872	229	3,821	43

Source: Wonogiri in Figures, 2002, BPS

Marketing of animals are made generally through 8 animal markets established at kecamatan level (about 60% in 2002) and the rest is traded directly through animal traders at village or kecamatan level.

Livestock support services are provided by the Livestock Sub-services of Kabupaten Livestock, Fishery and Ocean Services Office. The services provided include veterinary services, artificial insemination and extension activities. The artificial insemination and extension services are provided by field extension staffs deployed at kecamatan level.

(2) Inland Fishery

Inland fishery activities in the Wonogiri watershed are carried out in a sporadic manner and major kecamatans producing inland fishes include Wonogiri, Nguntoronadi and Wuryantoro. In Kecamatan Wonogiri, fish culture is predominant activities. However, in the latter two (2) kecamatans, catches in the Wonogiri Reservoir are primary fishery activities. Production of inland fishes in the project kecematans is shown in the following table:

Table 1.2.17 Fish Production in Project Kecamatans in 2003

Kecamatan	Fish Production	
	(t)	(%)
Wonogiri	764	39
Nguntoronadi	372	19
Wuryantoro	356	18
Other Project Kecamatans	478	24
Wonogiri watershed	1,970	100

Source: Wonogiri in Figures, 2003, BPS

1.2.4 Marketing

The prevailing marketing channel of major commodities produced in the project kecamatans is illustrated in Figure 1.2.4. As shown in the figure, production surpluses of all commodities are mostly marketed through village and/or kecamatan level collectors after some sorts of processing works or just after harvest.

However, there exist several commodities which are processed to final products at farmer levels. Such commodities include soybeans (tempe and tahu production), nillam (medical crop; extraction of oil) and cashew nut (processing to dry beans and extraction of shell oil). Further, partnership arrangements with private sector on production and marketing of medical crops and cashew nut are reported.

The watershed areas located at remote distance and being at critical level are distressed with less blessed natural resources or conditions of rainfed, steep slope and limited land holdings. However, the past endeavors toward improvement of welfare of rural people have developed several promising agri-business oriented activities. Such agri-business activities include: i) cashew nut production and processing, ii) medical crops production, iii) tempe and tahu production and iv) beneficiary activities of farmer groups of P4K program (Farmer Groups of Small-Scale Farmers).

1.2.5 Agricultural Support Services

(1) Institutions

The agency responsible for the provision of guidance and support on crop production in the kabupaten is the Agriculture Services Office. The organization structure of the Office is illustrated in Figure 1.2.5. As indicated in the figure, there are three (3) technical sub-services of Food Crops Agriculture, Estate Crops Agriculture and BIMAS Food Security. Since the introduction of the decentralization policy in Indonesia, the relation between provincial and kabupaten agricultural agencies has basically been reoriented mainly to technical issues. The Services Office is constrained with budget limitation and staff capabilities as well as the case of other kabupaten level institutions.

Support activities on livestock and fishery are provided by Livestock Sub-services Office and Fishery Sub-services of Livestock, Fishery and Ocean Services Office, respectively.

(2) Support Programs

The budgets for agricultural development or support activities at the kabupaten level are basically arranged in three (3) ways; one is within the district budget (decentralization budget; APBD II), the second is budget allocated from the provincial budget (APBD I) and the third is under the deconcentration budget (central government development budget, APBN) which is drown up initially at the province level and finally at the central level. The execution agency for the deconcentration budget is the provincial government and the APBN is accommodated in the development budget (DIP) of provincial agencies. In case of APBN, provincial agricultural services offices are responsible for the implementation of the programs or projects accommodated in the budget and the kabupaten agency becomes implementation agency under the guidance, supervision and monitoring of the provincial agencies concerned.

Support programs of the Agriculture Services Office directed to dry farm land or related with watershed conservation in 2003 are listed in Table 1.2.18. Major programs toward the said objectives include those shown below:

Table 1.2.19 Project Related Agricultural Support Programs in 2003

Program	Program Costs	Finance
Small Scale Farmers Income Generation	Rp. 291 million	APBN
KIMBUN Cashew Nut 1/	Rp. 107 million	APBN
Horticulture Crops Development	Rp. 127 million	APBD

Note: 1/; Development of Community Based Cashew Nut Agro-industry Area

(3) Extension Services

One of the main features of the decentralization policy in the agriculture sector is the devolution of agricultural extension activities to the kabupaten government. The institutions involved in agricultural extension services in the Wonogiri watershed include those shown below:

Table 1.2.20 Kabupaten Institutions Involved in Agricultural Extension Activities

Sub-sector	Institution
Food, Horticulture and Estate Crops	Agriculture Services Office
Livestock and Fishery	Livestock, Fishery and Ocean Services Office

1) Food, Horticulture and Estate Crops

The extension services to farmers are basically provided by the field extension workers (PPLs) belonging to the Agriculture Service Office, who guide and serve farmers through farmer groups in their working area. In the project kecamatans, PPLs are currently deployed by village(s) in coordination with the Extension Coordinator assigned on kecamatan basis. The working area of PPL is called WKPP (*Wilaya Kerja Penyuluhan Pertanian*/Working Area of Agricultural Extension). In the extension activities, a TV system is employed basically.

The number of extension staffs (Coordinator and PPL) deployed in the kecamatans in 2004 is shown in Table 1.2.21 and summarized below:

Table 1.2.22 Crop Sub-Sector Extension Staffs and Intensity of Deployment in Project Kecamatans

No. of Ext. Coordinator	No. of PPLs	Total	Farmland 1/	
			per PPL	per Staff
20	71	96	1,515 ha	1,121 ha

Note: 1/; Assuming total farmland of 107,600 ha
Source: Agriculture Services Office, Wonogiri

As shown in the table, the target farmland per extension staff is estimated at 1,121 ha, which are substantially lower than the general target of 500 ha per PPL in the past. Another essential problem is the deployment of extension staffs under different jurisdictions of agriculture and livestock and fishery agencies and the introduction of holistic approaches in extension activities appears not to have been achieved yet. The weaknesses or problems involved in the current extension services are:

- Limitation of funds for implementation of extension services programs and operation costs for extension workers,
- Insufficient number of extension staffs as indicated above,
- Capabilities of extension staffs on post-harvest technology and marketing issues still limited, and
- Coordination and collaboration of extension staffs under different jurisdiction

yet to be established to introduce holistic approaches for extension.

2) Livestock and Fishery

The deployments of livestock and fishery extension staffs in the project kecematans are also shown in Table 1.2.21 and summarized below:

Table 1.2.23 Livestock and Fishery Extension Staffs Deployed

Livestock		Fishery
Field Staff	Inseminator	Field Staff
18	14	14

Source: Livestock and Fishery Sub-services Offices

The weaknesses or problems involved in the extension services of the said sub-sectors appear to be similar to those for the crop sub-sector.

(4) Other Services

Other institutions involved in agricultural support services are listed in Table 1.2.21. Research activities are under the jurisdiction of the Integrated Agricultural Technology Assessment Center (BPTP Terpadu) located at Ungaran, Kabupaten Semarang. Provincial Plant Protection Center (BPTPH) is also at Ungaran. Five (5) seed farms are established under the kabupaten services office. However, they are poorly established and seed and seedling supplies in the project kecamatans are largely dependent on private sectors except those provided under support programs. No serious constraints for farm inputs supply except for their prices will be experienced by farmers in general except those in remote isolated areas since there exist a number of farm inputs kiosks in the kecamatans.

1.2.6 Farmers Organizations

A number of farmers organizations involved in agricultural activities are formed in the project kecamatans as shown in Table 1.2.24. Those farmers organizations are important agricultural institutions for the future promotion of agriculture development at kecamatan and village level and will become one of essential factors in the future promotion and development of agriculture and for the establishment of agribusiness oriented agriculture in the kecamatans. Some farmer groups are formed as beneficiary groups of government support programs and participated in program activities as explained in the following Section. Brief descriptions on major farmer groups are as follows;

Kelompok Tani (KT)

The number of KTs formed in the project kecamatans and their development status assessed by Agriculture Services Office are shown in Table 2.5.24. Within the kecamatans, 1,494 KTs are formed and they are classified into primary level (*pemula*) 604 or 40% of all, secondary level (*lanjut*) 555 or 37%, middle level (*madya*) 273 or 18% and advance level (*maju*) 62 or 4%. Activities of KTs are generally limited in technical issues and their economic activities such as group purchasing and marketing are seldom practiced. However, some farmer groups participated as beneficiaries in the government support programs as explained in the following Section.

KUD

KUD is organized in every project kecamatans and there exist 20 KUDs with varying degree of activities as shown in Table 1.2.21. Memberships of KUDs vary from some 1,700 to 9,200 and 4,600 on average. Main activities of KUDs are distribution of farm inputs, procurement of paddy, rice milling (RMU) and saving and credit services.

Beneficiary Kelompok Tani of Cashew Nut Program

These farmer groups are organized as beneficiary groups of cashew nut production increase program (Bagian Proyek Pengembangan Kawasan Industri Masyarakat Perkebunan Jambu Mete, Sub-project for Development of Community Based Cashew Nut Agro-industry Area) of the Agriculture Services Office. The program aims at motivating farmer groups toward agri-business activities of cashew nut processing and marketing by group. In the project kecamatans, 26 groups in 2002 and 15 groups in 2004 received program support concerning direct loan to farmer groups. Total amount received by those groups are Rp. million 120 in 2003 and Rp. million 300 in 2004.

Kelompok Tani Livestock (Ternak)

In the project kecamatans, 139 farmer groups for livestock activities are formed. Major activities of these groups are cattle or poultry raising.

1.3 Forestry and Watershed Management

The forest areas in the Wonogiri watershed are categorized into tate forest (*hutan negara*) and peoples forest (hutan rakyat). The state forest is managed and controlled by State Forest Company (*Perum Perhutani*) and the people's forest is under the control of individual land owners. In the peoples forest, community based forestry development activities are promoted by the forestry agencies.

1.3.1 Current Statuses of State Forest

The state forest in Java Island is under the jurisdiction of State Forest Company of the Ministry of Forest and the same in the Wonogiri watershed is under the management and control of KPH Surakarta (*Kesatuan Pemangkuan Hutan*/Forest Administration Unit). The kabupaten/kecamatan level operations of KPH are executed through BKPH (*Bagian Kesatuan Pemangkuan Hutan*/ Forest Administration Sub-unit) established at watershed levels and field level operations are carried out by RPH (*Resort Pemangkuan Hutan*/Field Unit of KPH) as shown in Figure 1.3.1.

The Wonogiri watershed is mostly under the control of 4 BKPHs[4] and 17 RPHs as follows:

Table 1.3.1 BKPH Related to Wonogiri Watershed

BKPH	State Forest (ha)	No. of RPH
Wonogiri	6,274	5
Baturetno	6,819	5
Luwu Selatan	4,594	3
Purwantoro	4,350	4

Source: Perum Purhutani KPH, Surakarta

The current statuses of the state forest in the Wonogiri watershed, classified by the KPH, are shown in Table 1.3.2 and summarized below:

[4] BKPH boundaries are not consistent with the Wonogiri watershed boundary and part of the piedmont areas of Mt. Lawu is under BKPH Lawu Utara.

Table 1.3.3 Current Status of State Forest Related to Wonogiri Watershed in 2004

(Unit: ha and %)

Production Forest			Less Productive	Protected	Total
Productive	Not Planted	Others 1/	Forest	Forest	
14,821ha	448 ha	2,105 ha	1,312 ha	3,351 ha	22,037 ha
67%	2%	10%	6%	15%	100%

1/: Include unsuitable area and others. Source: Perum Purhutani KPH, Surakarta

The substantial degradation of the state forest in the Wonogiri watershed is reported to be caused mainly due to illegal logging during the reformation of political regime in 1998/99. However, the reforestation in such degraded areas and harvested areas have been carried out continuously by 4 BKPHs and are scheduled to be completed by 2007 as shown in Table 1.3.4. The overall reforested areas from 2000 to 2004 reach 3,170 ha and the planned reforesting areas from 2006 to 2007 are 743 ha.

The current statuses of each category of forest are as follows;

(1) Protected Forest

The protected forest is forest areas having main functions as living buffer zone, water resources conservation, flood protection, erosion control and mitigation of sedimentation in lower reaches. The forests in the Wonogiri watershed are mostly of natural forests and partly afforestated areas. The areas designated as the forests in the Wonogiri watershed are found only in the upper reach of Keduang Sub-basin in the command areas of BKPH Luwu Selatan and Luwu Utara. Current statuses of the forest vary depending on locations. However, substantial encroachments of villagers for seasonal crops cultivation in the afforestated areas are noticed.

(2) Production Forest

The production forest is defined as a forest of which main function is production of forest products. The production forests in the Wonogiri watershed are afforestated forests and the areas designated as the production forests are distributed in mountain slopes of Tirtomoyo, Keduang, Solo Hulu and Alang Sub-basins. The forest areas are categorized by Perum Perhutani into: i) merkusi pine forest (*Pinus merksii*), ii) sonokeling forest (*Darbegia grandis*), iii) forest of other than pine or *sonokeling,* iv) area unsuitable for forestry production, v) not planted area and vi) others.

The most dominant tree species in the production forests is merkusi pine used as construction material, followed by sonokeling used for furniture making. Other important species planted in the forests include mahogany (*Swietenia machopylia*; furniture) and teakwood (*Tectona grandis*; construction material).

For the afforestation and management of the production forests, two (2) systems are employed by the State Forest Company. One is a *tumpansari* system (*sistem tumpansari*) under collaboration with Forestry Farmer Groups (*Kelompok Tani Hutan*) and the other is a hired labor system (*banjar harian*).

Under the *tumpansari* system, afforestation and forest management works for the initial 4 to 5 years and selective cutting are carried out by the Farmer Groups under a contracting system with the Company. In the system, the farmer groups are allowed to intercrop seasonal crops (excluding cassava) for 3 years. The majority of the production forests in the Wonogiri watershed are managed by adapting this system.

In the hired labor system, the Company implements afforestation, forest management

works and selective cutting by employing individual farmers or farmer groups. In this system, no intercropping of seasonal crops is allowed. In both cases, harvesting of trees is done by the Company.

Major problems that the production forests face are reported to be illegal cutting, encroachments for seasonal crops cultivation and capabilities of field staffs.

(3) Less Productive Forest

The less productive forest is defined as a forest in areas with poor land capability for forestry production. The less productive forests are limited in extent in the Wonogiri watershed and distributed in such tributary basins as the Eromoko, Wuryantro, Ngunggahan and Alang.

1.3.2 Current Statuses of Peoples Forest (Hutan Rakyat)

The peoples forests (*hutan rakyat*) are defined as forest areas owned and operated by individuals (villagers/farmers)[5]. The extent of the forests in the project kecematans in the Wonogiri watershed is reported to be some 13,900 ha by the Kabupaten Forestry Sub-services and extensively distributed in the mountainous areas of the Wonogiri watershed, especially in Kecamatan Pracimantoro and Giritontro as shown in Table 2.6.5. The peoples forests in the Wonogiri watershed are classified into two (2) types of: i) forests established under government subsidy or projects (*swadaya perbantu*) and ii) forests established by owners self-help efforts (*swadaya murni*). The majority of the peoples forests in the area are developed by the latter self-help activities.

All the peoples forests in the project kecematans are afforestated forests and a greater part of them are managed under an agro-forestry system called tumpansari where multiple planting of trees and seasonal crops are practiced. Dominant tree in the forests is teakwood. Other tree species planted include: sengon (*Albizia falcata*), mahogany, acacia (*Acacia auriculiformis*) and Eucalyptus (*Eucalyotus degluputa*). Predominant accompanying seasonal crops include maize, cassava, beans and medical crops. However, there exist peoples forests managed under a monoculture system of trees to a limited extent. Such forests are found in Selopuro (mahogany) and Sumberejo (teakwood) of Kecamatan Batuwarno and in Jatirejo and Bayeharjo (teakwood) of Kecamatan Giritontoro.

1.3.3 Current Statuses of Community Based Forestry Conservation Development

The community based forestry development activities are implemented in the Wonogiri watershed by Forestry Sub-services and State Forest Company to a large extent with the support of NGOs at farmer groups' level. The community based development by the Sub-service is carried out under the program of Gerhan Peoples Forest Program. The same by the Company is under the Desa Model PHBM Program (Model Village for Community Participated Forest Management /*Pengololaan Hutan Bersama Masyarakat*).

(1) GERHAN (National Movement for Forest and Land Rehabilitation*)*

The Wonogiri watershed is one of the main targets of the national project for watershed conservation, GERHAN. The APBN budget under GERHAN allocated for the kabupaten was Rp.8,950 million in 2003 and Rp.11,283 million in 2004.

1) Objectives and Scopes

[5] Reported that no customary or traditionally owned communal forests exist in the Wonogiri watershed.

The objectives of GERHAN are to execute integrated and programmed forest and land rehabilitation efforts by involving government institutions, private sector and communities for recovery of watersheds functions, rehabilitation of jeopardized forest and land resources and reducing natural disasters of flood, land slide and drought. GERHAN has been planned for the period of 5 years from 2003 to 2007 with the national overall target areas of 3 million ha. The programs in 2003 were implemented in 29 river basins extending in 15 provinces or 145 kabupaten/cities. In 2004, the target area has been expanded to 141 river basins extending in 31 province or 372 kabupaten/cities.

The executing agency of GERHAN is the Ministry of Forest under the support of three (3) Coordination Ministers of Welfare, Economy and Policy and Security. The implementation agency at the central level is the Director General of Land Rehabilitation and Social Forestry and the same at kabupaten level is kabupaten forestry services agencies.

2) GERHAN Programs in Wonogiri Watershed

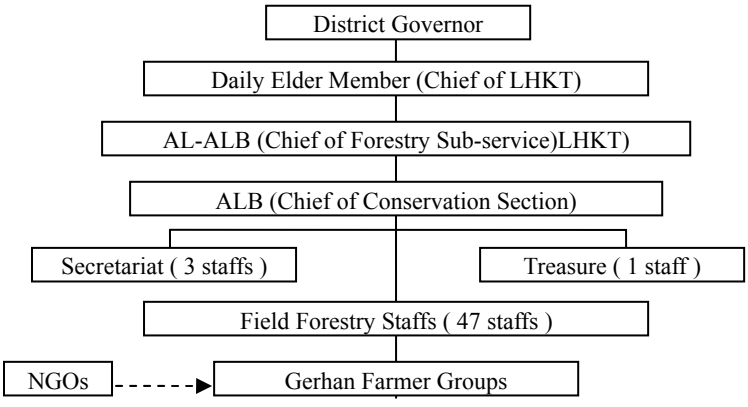
In the Wonogiri watershed, the GERHAN activities are implemented from 2003. The programs executed in the area include fiver (5) programs. All the programs in 2003 and 2004 have been executed as planned in the previous years. The programs and volumes implemented in 2003 and 2004 are shown below:

Table 1.3.5 GERHAN Implemented and Planned in Wonogiri Catchment

Programs	Volume of Programs	
	2003	2004
Hutan Rakyat (community forest)	5,031 ha	5,650 ha
Check Dam	-	1 unit
Gully Plug	30 units	-
Absorption Well	50 units	10 units
Small Reservoir	50 units	30 units

GERHAN programs in 2005 in the kabupaten have not been approved at the central level (as of June 2005). However, the budget allocation similar to 2004 is expected.

The GERHAN programs in the Wonogiri watershed are implemented by Forestry Sub-services of LHKT with the institutionalized participation of beneficiary farmer groups and NGOs and under the supervision, guidance and monitoring of BP DAS, Solo. The organization set-up for the implementation is illustrated below:



AL-AB (Atasan Langsung ALB): Direct Superviser of ALB
ALB (Atasan Langsung Bendaharawan): Direct Superviser of Treasurer

Figure 1.3.2 Project Organization for GERHAN in Kabupaten Wonogiri

(2) Conservation Activities by Other Agencies

BP DAS Solo as a technical implementation unit of Directorate General of Land Rehabilitation and Social Forestry has some allocation of budget for conservation activities as shown in Table 1.3.6. As shown in the table, the primary activity in 2004 was "seedling production (procurement) for GERHAN".

Agricultural support programs of the Agriculture Services Office directed to dry farm land or related with watershed conservation in 2003 are listed in Table 1.3.7. Major programs toward the said objectives include those shown below:

Table 1.3.8 Project Related Agricultural Support Programs in 2003

Program	Program Costs	Finance
Small Scale Farmers Income Generation	Rp. 291 million	APBN
KIMBUN Cashew Nut [1/]	Rp. 107 million	APBN
Horticulture Crops Development	Rp. 127 million	APBD

Note: 1/; Development of Community Based Cashew Nut Agro-industry Area

The planned watershed conservation related activities of the Office and Livestock Sub-services Office in 2005 are as follows:

Table 1.3.9 Major Watershed Conservation Related Activities Planned for 2005

Services/Sub-services	Major Watershed Conservation Related Programs in 2005
Agriculture Services	- Organic fertilizer promotion, Credit for farmer groups
	- Estate crops development, Distribution of fruit seedling
Livestock Sub-services	- Cattle genetic improvement, fodder crops development

1.3.4 Status of Activity for Tree and Tree Crops Nursery

Tree and perennial crops nurseries and seedling production in the watershed are classified by institutions operating them into four of: i) nurseries operated by KPH (BPKH Luwu Selatan), ii) nurseries operated by farmer groups, iii) seedlings produced or supplied by private firms and iv) Horticulture Seed Farm of Agricultural Services Office as shown in Table 1.3.10.

BPKH Luwu Selatan has annual production capacity of 800,000 to 1,000,000 seedlings of pine (*Pinus merkusii*). The nursery of the BPKH is producing pine seedlings required by the state forest in Wonogiri. Seedlings of other species needed in BPKHs in Wonogiri are supplied from the KPH nurseries in Kabupaten Klaten.

Production of seedlings by farmer groups is carried out under the partnership arrangement with private firms and seedling production in such a way is a main stay in Wonogiri as shown in the table. CV. Lulus Tani at Kec. Ngadirojo operating in Wonogiri is a private firm producing and supplying seedlings under the partnership arrangement with farmer groups. The firm was a seedling supplier for the people's forestry program of GERHAN in 2004 and currently having partnership arrangements with 4 farmer groups in Wonogiri and 2 farmer groups in East Java. Reportedly, the firm supplied about 3.5 million seedlings in 2004. CV. Kencana Wilis located in Kabupaten Karangayar is also a seedling supplier for GERHAN 2004 and has started a partnership arrangement with a farmer group in Wonogiri. Major constraints of farmer groups involved in seedling production are reported to be: i) unstable demand for seedlings and ii) lack of proper technical guidance. The promotion of nursery development of the private sector by coping with such constraints will be an important development issue to ensure supply of necessary seedlings for future watershed conservation activities

1.3.5 Forestry Support Services

(1) Institutions

The forestry support services for smallholders are provided by Forestry Sub-services of Wonogiri Human Environment, Forestry and Mining Services Office (LHKT Wonogiri). The Sub-service is composed of 4 technical sections of: i) Forestry Rehabilitation, Protection and Production, ii) Soil Conservation, iii) Technical Guidance on Processing and Marketing of Forest Products and iv) Community Empowerment as shown in Figure 1.3.2. Among the sections, the sections closely related with the present Study are Soil Conservation Section and Community Empowerment Section.

Support services at village or field levels are provided by field extension staffs deployed at the kecamatan level; Forestry Coordinator and PKL (Field Forestry Extension Worker/Petugas Kuhutanan Lapgan). The number of Coordinators and PKLs in the project kecematans is 19 each as shown in Table 1.3.11.

Other major forestry support institutions or facilities available in and around the kabupaten include five (5) village nurseries (KBD/Kebun Bibit Desa) and one (1) central government (SB River Solo) training facility. No government nursery farm is established in the kabupaten. Supply sources of tree seedlings include: i) KBDs operated by farmer groups organized under the support programs of the Sub-services in the past (teakwood and fruit trees), ii) State Forest Company, and iii) farm inputs dealers in and around the kabupaten.

Constraints for forestry development faced by the Sub-service are administrative budget limitation and technical staff capabilities as well as the case of other kabupaten level institutions.

(2) Support Programs

Main budget sources for forestry support activities are accommodated in the district budget (decentralization budget; APBD II) and the deconcentration (central) budget (APBN). However, the Wonogiri watershed is one of the main target watersheds of the national project for watershed conservation, GERHAN (National Movement for Forest and Land Rehabilitation). The APBN budget for GERHAN allocated for the kabupaten was Rp.8,950 million in 2003 and Rp.11,283 million in 2004. Therefore, the most important forestry support activities in the kabupaten are the activities implemented through GERHAN Program. While, support programs for watershed conservation in the Wonogiri watershed under the district budget in 2004 include village nursery development (2 units) and construction of gully structures (plug and head structures, 12 units).

1.3.6 Assessment to IBRD Project (Upper Solo Watershed Protection Project) in Wonogiri Watershed

The Government of Indonesia has encountered serious problems on frequent occurrence of flood damages in the Solo River basin in early 1960'. For solving problems of floods, the Government performed the Re-greening Program. Then UNDP/FAO conducted soil erosion control project from 1971 to 1975 to establish appropriate techniques for soil and erosion control in the Solo River basin consisting of 4 sub-basins of the Padas, Samin, Tirtomoyo and Temon. After this project, UNDP/FAO started the project entitled 'the Upper Solo Water Protection Project' through people's participation and income generation based on lessons learned and obtained in the above UNDP project and finished

in 1985.

These soil erosion control projects during the period of 1960s to 1985 did not always make a great effect for prevention of soil erosion. To improve soil erosion in the watershed of the Solo River, a comprehensive and integrated project entitled 'The Upper Solo Watershed Protection Project' financed by the IBRD (hereinafter called IBRD Project) was commenced from 1988/89 to 1994/95.

(1) Project purpose of Upper Solo Watershed Protection Project

This project aims at: (1) control and prevention of soil erosion and sedimentation into the Wonogiri Dam, (2) rising of living standard of the farmers in the basin through improvement of agricultural productivity and incomes, (3) dissemination of conservation practices that farmers can carry out them with self-reliance and (4) enlightenment of environment improvement to people.

(2) Project features of IBRD Project

The project covered 18 kecamatans consisting of 172 villages. The total beneficiary farmers' area is estimated at about 28,300 (not only landowner, but also tenant farmers). The main features of the IBRD project are summarized below:

Table 1.3.12 Project Feature of IBRD Project

Work items	Target	realization	Ratio of realization per target	Cost Million (Rp)	Share to total cost (%)
(1) Civil works					
a. gully head structure	250 units	250unit	100	146.1	0.8
b. small reservoir	40 units	40 units	100	1,117.2	6.2
c. big gully plug	160 units	160 units	100	597,494.2	3.2
d. small gully plug	1,300 units	1,310 units	100.8	725.4	4.0
e. slopping grassing	200,000m^2	213,000 m^2	106.9	212.8	1.2
f. stream bank protection	5,000m	7,748m	155	1,052.5	5.8
g. road side protection	50 km	75 km	150	1,413.5	7.8
h. rainfall storage tank	-	1 unit	100	5.5	-
Sub-total				5,252.5	29
(2) seedling bed	500 units	694 units	139	217.9	1.2
(3) communal forest	5,000 ha	6,600 ha	133.2	1,356.2	7.5
(4) rehabilitation of terrace	22,000 ha	22,000 ha	100	9,389.4	51.8
(5) green belt	500 ha	600 ha	120	96.2	0.5
(6) Integrated watershed development at Beji dan Gobeh		2 unit (1,385 ha)	100	498.9	2.8
(7) home yard conservation	-	1,000 ha	100	100.0	0.6
(8) Extension	-	200 kel. tani	100	18.6	0.1
(9) land certification	22,000 ha	22,000 ha	100	804.5	4.4
(10) Procurement of equipment	-	21 unit	100	381.4	2.1
Total				18,116	100

As shown in the above table, the project consists of ten (10) components. The total project cost is Rp.18,116 million (equivalent to about US$ 9.8 million at present under assumption of US$=Rp1,850: average value from 1988 to1991). The most important components among those components are rehabilitation works of the terrace and civil works for soil erosion control, having a share of 77.8% of the total project cost.

(3) Assessment of Approach to Project Realization

Based on the results and lessons learned from the previous UNDP/FAO projects, approach to the project realization is set from the viewpoint of 'bottom up approach' instead of 'top down approach'. The project implementation was conducted in three (3) stages, from RTL (field technical planning), through RTT (yearly technical planning) to Detailed design.

However, according to the final report titled monitoring and evaluation prepared by BCEOM in July 1991, farmers and farmer's group participated only in the final design stage and it is uncertain that true needs and requirement of the farmers are sufficiently reflected into the development of soil conservation project. The bottom-up approach to the project was not undertaken entirely. The final report assessed that the bottom-up approach to the project was not undertaken entirely.

In the actual identification of location for implementation of vegetative works as well as civil works for erosion control to be contained in the annual implementation plan in RTT report, the approach adopted by BP DAS follows a different line. An integrated and comprehensive approach based on site specific characteristics is not followed. The result is the project works for soil conservation implemented that often remain rather scattered, while preventive works for soil conservation were lack behind or put aside as second priority. The unbalanced geographical distribution of implemented works reveals the lack of an integrated approach based on the watershed management needs that ultimately renders poor results on the actual erosion control efforts. The reasons for above problems are considered lack of reliable information and the adopted 'distribution of welfare' approach, for which project expenditures are needed to be spread as much as possible among villages and communities in the project area.

(4) Assessment of the IBRD Project

Monitoring and evaluation for the IBRD project were done by BCEOM consultants in 1991/92 on the way of implementation period of the project. The preliminary results of monitoring and evaluation were not prepared for the whole project works, but for about 80% of the total projects works. In this section, a lot of assessment results in the above report were referred to.

- Selection of the objective area for soil conservation:

The result of assessment indicated that the works were not implemented for the most critical areas for soil conservation, which were selected based on the selection criteria, but for the considerable areas with less priority were performed.

- Civil work structures for soil erosion control:

Effectiveness and condition of the civil works for soil erosion control such as gully plugs, gully head structures and sloping grassing sites are shown in the following tables.

Table 1.3.13 Condition of Civil Works

Item of Condition	Nos.	(%)
Condition of gully plugs (gabion type)		
1. structure is good condition and is collecting sediment	354	47
2. Structure is good condition, but little/not collecting sediment	250	33
3. Part of the structure is broken.	106	14
4. Whole structure is broken.	40	5
Total	750	100
Condition of gully plug without earthen side walls		
1. earth wall is stable and grassed.	156	35
2. big settlement in wall, needs maintenance but grassed.	230	51
3.structure is leaking below wall.	63	14
4. Whole structure is broken.	1	0.2
Total	450	100
Condition of gully head structures		
1. gully head structure is stable and sound.	21	44
2. structure is in broken condition.	10	21
3. structure is damaged, wall is hanging.	2	4
4. new gully head appears the old one.	5	10
5. structure is not effective in controlling gully head.	1	2
6. structure is broken and new gully heads appears.	8	17
7. structure is not effective in controlling gully head and new heads appear.	1	2
Total	48	100
Condition of slopping grassing sites		
1. site is stable, covered with grass and/or legumes.	6	12
2. site is mostly stable, partly covered with grass/legumes, but slight erosion occurs.	32	64
3. site is unstable, no cover of grass/legumes, sever erosion.	12	24
Total	50	100

Source: Bcoem evaluation report

In 1991/92, 50% of the gabion gully plugs requires a lot of maintenance due to improper site selection and improper design. 50% of gully plugs with earth cut-off banks needs repair. 44 % of gully head structures are stable and the remainders are damaged and/or not effective. About 75 % of the sites were mostly stable. It was impressed in the JICA survey that a number of gully structures were broken and not rehabilitated. It may be concluded that proper design and maintenance of the project works is very important for soil conservation management.

- Rehabilitation of terraces:

The effectiveness and the conditions of the rehabilitated terraces in 1991/1992 are shown in the following table:

Table 1.3.14 Condition of Rehabilitation of Terrace

Item of Condition	Nos.	(%)
Condition of rehabilitated terraces –terrace lips		
1. terrace lips are fully grassed and with perennial vegetation	2	2
2. terrace lips are only partially grassed	70	63
3. terrace lips are not grassed at all	18	16
4. on terrace lips, cassava is growing	7	6
5. terrace lips are partially grassed, but cassava is grown	15	13
Total	112	100
Conditions of rehabilitated terraces-terrace risers		
1. terrace risers are fully grassed and/or with perennial vegetation	2	2
2. terrace rises are partially grassed	94	78
3. terrace risers are not grassed at all	24	20
Total	120	100
Conditions of rehabilitated terraces-drains		
1. drains are clean	56	52
2. drains are clogged with earth and vegetation	40	37
3. no drains are made nor available	12	11
Total	108	100
Condition of rehabilitated terraces-waterways		
1. waterways are functioning well	31	29
2. waterways started to break	23	21
3. no maintenance of water way	40	37
4. no waterways are available	14	13
Total	108	100
Condition of rehabilitated terraces-Terrace benches		
1. terrace benches are leveled with lips and reverse slope	63	56
2. terrace benches are leveled without lips/reverse slope	28	25
3. terrace benches are not leveled without lips/reverse slope	2	2
4. terrace benches are not leveled with lips and reverse slope	19	17
Total	112	100

Source: Bcoem evaluation report

According to the above tables, the terraces having lip fully covered by grass and riser also fully grassed are very small at only 2 %. 65% of the terrace lip is partially grassed. 78% of terrace rise is partially grassed, while 20% of terrace is not grassed at all. Only 56% of the terrace bench is leveled with reverse slope, while remainders are not leveled. About 70% of waterways were not functioned well. It can be said that about 70% to 80% of the terraces were in the class of incomplete bench terrace.

It is considered that most of the terrace rehabilitated by the IBRD project had been degraded for about the recent 15 years. Causes of the degradation of the bench terraces are attributed to mainly no maintenance of terraces by farmers.

- Agricultural production increase program from terrace rehabilitation:

In line with the terrace rehabilitation project, agricultural production increase program for seasonal crops and perennial tree crops was conducted for the whole rehabilitated terrace of about 22,000ha. The beneficiary farmers in this program are farmers who actually cultivate the upland fields selected in the IBRD project and amount to about 28,300.

The components of this program are (1) construction of boundary pole, project signboard, field house and data board, (2) procurement of one hand sprayer, (3) provision of farm input including grass for terrace riser, and (4) construction of waterway and drop structure. All the necessary costs of the project components were given to the farmers group by subsidy from the Government.

In regard with provision of farm input, all farm input cost for only 1st rainy seasonal crops (MT-I) as revolving fund and perennial crops (subsidy) were given to each beneficiary farmer on the basis of his upland field size through the farmers group. Dosage of farm inputs per ha is as follows:

Table 1.3.15 Design Value of Farm Inputs

Items of farm inputs	Dosage/ha
(A) Fertilizer and chemicals	
1. Urea	265 kg
2. TSP	110 kg
3. KCL	66 kg
4. Agricultural chemicals	0.9 l
5. Agricultural chemicals	15kg
(B) Seeds and/or seedling	
1. Maize	About 9kg
2. Upland paddy	35.5 kg
3. Soy beans	35.5 kg
4. Cassava	340 stick
5. Perennial crops (mango, cashewnut, coconut, Jack fruit, Mlingo and Pete)	20 seedling
(C) Grass for terrace risers	
1. Grass fro terrace risers	$15m^2$
2. Stone for drop structure	$2.3m^3$

After the harvest of 1st rainy seasonal crops, the farmers have to pay back input cost in cash to the farmers group. However, since there is no penalty of delinquent for repayment, revolving funds were not used for farm input costs, but for cost of living. Revolving fund system in most farmers groups did not run.

Seedlings of perennial crops were given to each farmer at a rate of 20 seedling per ha. Kind of crops consists of mango, cashew nut, coconut, Nanka, Mlingo and Pete. The farmers can select kinds of perennial crops in their will. Often these seedlings were not planted in the terrace areas, but in home settlement area. The cropping of these perennial crops in the terrace area seems to give the effect of erosion control.

- Land certificate program:

In line with the terrace project, the land certification program was conducted. All the terrace lands owned by about 18,200 landowners were registered. Fee necessary for land registration is subsidized by the Government. This program was a great incentive to the farmers for development of the watershed management in the Wonogiri catchment.

- Community forest:

The community forest program was conducted for the critical lands with over 45% in steepness that were clarified by RTL among the community land areas, as well as lands abandoned by the farmers. The area of the community forest is about 5,000 ha. The varieties planted in this program are 1) Mahogany, 2) Accasia auriculiformis, 3) Eucalyptusalba, 4) Albisia falcate and fruits/industry commodity such as mangoes, cashew nuts, pete (a tree that produces beans with pungent odor), jack fruits, Mlingo. Seedling per ha is from 1,600 to 2,000.

The most serious problems are low rooting and low growth of the trees in the seriously critical lands with insufficient depth of effective soil and low fertility. Also the participation ratio of the farmers is very low due to low incentives. Although no data of the conditions are available in the whole watershed, some community forests inspected in the Study were very effective for soil erosion. Behavior for reluctance and low incentive

to the project will be improved through strong enlightenment to the farmers.

- Burden of the farmers that participated in the project:

All the project costs are subsidized by the Government. The farmers who participated in the project have no responsibility of voluntary labor contribution for the project construction and provision of some materials necessary for the project. Concerning labor force required for the project, the participated farmers were employed. According to the interview to governmental staff engaged in the project, self-reliance spirit for the development was degraded.

1.4 Sediment Yield from Soil Erosion of Land Surface

1.4.1 General

(1) General

Based on the results of the field survey and analysis of the main sources of soil erosion from the cultivated lands, it may be concluded that soil erosion sources are considered as shown below:

i) The main sources of soil erosion are the upland fields with no terrace where extend over steep (over 10% in gradient) mountainous areas in the upper streams of the Keduang, the Tirtomoyo, the Upper Solo, the Alang and the Ngunggahan. Also deterioration of bench terrace lands becomes one of the most important factors for acceleration of soil erosions.
ii) Soil erosions of the home settlement area: the total home settlement areas occupy about 22% of the total catchment area. A considerable land of the settlement area is used as upland field with composite (no terrace and ridge terrace), mainly for cassava cultivation. In case of the Kuduang river basin, a lot of rivers run from north to south and dissect deeply the lands. The home settlement area is located at the back of which both sides are generally dissected by rivers. So the slope of the home settlement areas is steep, often over 20%. A lot of roots of the trees in the home settlement area appear due to soil erosion.
iii) Intensity of the 2nd cropping season (from middle of February to end of May) in the upland field shows about 40%. So the remaining (60%) areas become bare land. Bigger rainfalls still occur in this cropping season and serious soil erosion is expected to bring about.
iv) About 50% of the total upland fields are covered with bench terrace in spite that the 80% of the total terraces are poor due to fairly or no maintenance. The remainders are covered with traditional terraces, ridge terraces, non-terraces and composite of ridge terrace/non-terrace. Especially, most of the upland fields extending over the steep mountainous areas in the upper reaches of the main rivers in the Wonogiri watershed, the most critical upland field areas where are considered as most serious potential areas producing sediment yield, were not installed by bench terrace. Most of these upland fields are covered by traditional terraces, ridge terraces, non-terraces and composite of ridge terrace/non-terrace. Such improper terrace conditions result in acceleration of soil erosions in these critical areas.

1.4.2 Estimate of Soil Loss from Land Surface

(1) General

Land surface soil erosion from land surface in the Wonogiri watershed area is analyzed by using the Universal Soil Loss Equation (USLE), which is the most widely method used

around the world to predict long-term rates of rill erosion from field or farm size units subject to different management practices. The USLE[6] was developed based on thousands of plot-years of data from experimental plots, and although the initial focus was oriented primarily toward conditions in the middle and eastern United States, the USLE has been extended and applied worldwide. In order to estimate annual sediment production, GIS system was set up by the use of Arc view Ver.9.0 software. The rainfall erosivity map prepared by rain erosivity index, the soil map with soil erodibility, the topographic factor map with slope length and steepness, the crop management map, and the erosion control practice factor map with terrace condition were prepared and each map was put into the GIS system in the form of a layer. These maps are divided into a grid of 20m x 20m.

(2) USLE Equation

The USLE is an empirical multiple-regression-type equation which incorporates the parameters that influence erosion, and is expressed by the following equation:

$$A=R \cdot K \cdot L \cdot S \cdot C \cdot P$$

where,

A: Average annual soil loss
R: Rainfall erosivity factor
K: Soil erodibility factor
L: Slope length factor
S: Slope steepness factor
C: Crop management factor
P: Support practice factor

(3) Rainfall Erosivity Factor (R)

The rainfall erosivity factor is obtained from the rainfall erosivity index (REI). The REI was calculated from the following formula used by the Ministry of Forestry in Indonesia.

$$Re = 2.21 \times \sum_{i=1}^{12} R_i^{1.36}$$

where,

Re: Rain Erosivity Index
Ri: Monthly rainfall (cm)
i: Month (January to December)

Monthly rainfall data for 24 years from 1982 to 2004 calculated from 15 rainfall stations in and around the Wonogiri watershed was used. The rainfall erosivity factor "R" is calculated and shown below.

[6] Gregory L. Morris, and Jiahua Fan, 1997, "Reservoir Sedimentation handbook", pp. 6.23-6.25

Table 1.4.1 Rainfall Erosivity Index "Re" and Factor "R"

Rain Erosivity Index (Re)	Rainfall Erosivity Factor (R)
1,000-1,100	1,050
1,100-1,200	1,150
1,200-1,300	1,250
1,300-1400	1,350
1,400-1,500	1,450
1,500-1,600	1,550
1,600-1,700	1,650
1,700-1,800	1,750
1,800-1,900	1,850
1,900-2,000	1,950
2,100-2,200	2,150
2,200-2,300	2,250
2,300-2,400	2,350
2,500-2,600	2,550

Source: JICA Study Team

(4) Soil Erodibility Factor (K)

To determine "K" values of the representative soils in the Wonogiri watershed, diagonoses of soil profile, soil particle distribution analysis and basic intake rate measurement were conducted (detailed in the Progress Report (2), August 2005). The K values were determined based on the results of the analysis and monograph for computing the K value of soil erodibility for use in the USLE. The computed "K" values are listed below.

Table 1.4.2 Applied Soil Erodibility Factor "K"

Kind of soils	Soil erodibility factor (K)
Mediteran soils	0.31
Grumsols	0.48
Latosols	0.32
Lithosols	0.015*

* This figure is taken from rehabilitasi lahan dan konservasi tanah daerah tangkapan waduk serbaguna Wonogiri BukuII Lampiran teknik

Source: JICA Study Team

(5) Topographic Factor (LS)

Topographic factor (LS) is calculated based on the following equation.

$$LS = \sqrt{\lambda/22.1} \cdot (65.41 \sin^2 \theta + 4.56 \sin \theta + 0.065)$$

where,

LS: Topographic factor
λ: Slope length
θ: Steepness

In this calculation, slope length (λ) was fixed as follows. The slope length of terraces was classified into 5 classes based on the results of the survey on the present terrace condition.

Table 1.4.3 Slope Length for Classified Land Uses

Land Use	Slope Length (m)/Slope(%)
(1) Upland field, paddy field, orchard and plantation area, dry farming land in home settlement area	
a) class-1	8 m /0-8%
b) class-2	8 m /8-15%
c) class-3	4 m /15-25%
d) class-4	3 m /25-40%
e) class-5	2 m /over 40%
(2) Others	50 m

Source: JICA Study Team

Steepness (θ) was calculated based on GIS data prepared by BAKOSURTANAL. The steepness value of 50% gradient is applied for all the upland fields having a steepness of over 50%.

(6) Cover and Management Factor (C)

Cover and management factor "C" for land use categories used in the land use map in the Wonogiri watershed are as follows:

The cover and management factors were generally determined by reference to Badan Penelitian dan Pengembangan Pertanian Departmen Pertanian 1990 and the diagram the reports of Rencana Teknik Lapangan (1985) as presented below.

Table 1.4.4 Cover and Management Factor "C"

Land use	Cover and Management Factor (C)
Paddy field	0.05
Home settlement areas	0.1
Uplands in settlement area	0.7
Uplands	
1-MT-I: average annual crop factor for mixed cultivation of maze and cassava	0.6
2-MT-II: average annual crop factor for mixed cultivation of beans and cassava	0.45
3-MT-III: average annual crop factor for mixed cultivation of beans and cassava	1
Grassland /Bush land	0.02
Forest	0.01
Orchard/Plantation	0.3
Bare lands	1.0
Water body	0

Source: JICA Study Team

In Wonogiri, dry farm lands are largely governed by those of seasonal crops. The overall cropping intensity on the dry farm lands comprises a 1st cropping season for 100%, second cropping season for 40% and third cropping season for 1% as shown below.

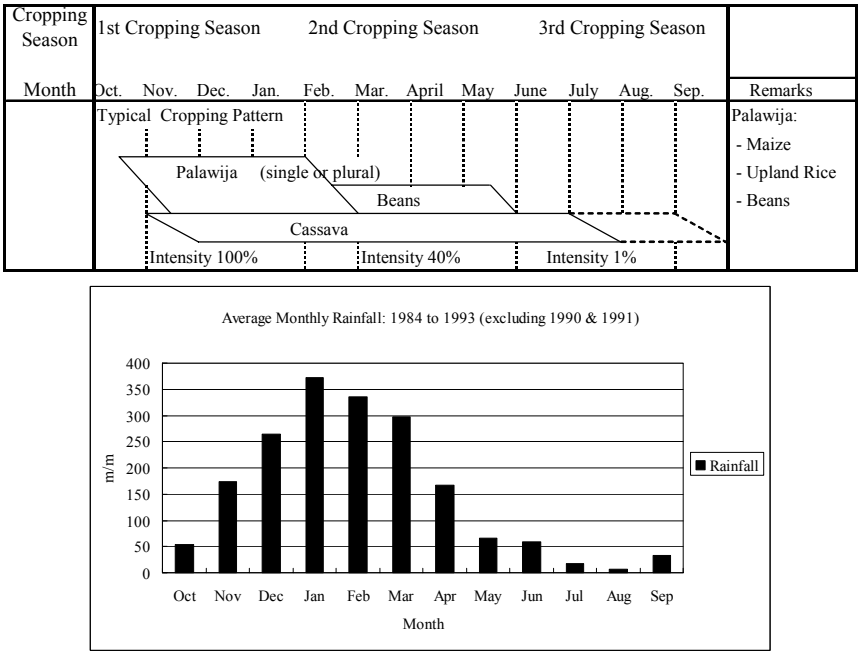


Figure1.4.1 Typical Cropping Schedule and Mean Monthly Rainfall in Wonogiri Watershed

As above figure, the cropping intensity for the second cropping season is about 40%. The remaining 60% becomes bared for February to May when a large rainfall still occurs, which causes seriously soil erosion. In order to obtain an accurate value for the crop factor, an overall cover and management factor for upland areas is calculated by the following equation by using a cropping intensity data at the Kecamatan level

$$C = (Ci \cdot Ri + Cii \cdot Rii + Ciii \cdot Riii + \cdots + Cxii \cdot Rxii)/Ri\sim xii$$

where,

C: Annual overall cover and management factor C

Ci: Average annual crop factor for mixed cultivation of cassava and maize and mixed cultivation of cassava and beans

Ri: Monthly rainfall erosivity factor for i□t h month

Ri~xii: Annual rainfall erosivity factor (accumulated Jan. to Dec.)

The cover and management factor C for the upland fields is changed on the basis of cropping intensity in Kecamatan areas.

(7) Support Practice Factor (P)

The support practice factor "P" for land use categories of the land use map in the Wonogiri watershed is mainly determined in reference to the data and information of the diagram "Parameter of C" in the reports of Rencana Teknik Lapangan (1985) and Risalah Lokakarya Pemantapan Perencanaan Konservasi Tanah dan Evaluasi Tingkat Erosi, Proyek Penelitian Penyelamatan Hutan, Tanah dan Air Pebruari 1990 as follows:

Table 1.4.5 Support Practice Factor "P"

Erosion-control practice	P-factor value
No treatment of soil conservation	0.8
Ridge terrace	
Composite (land of composite of condition of ridge terrace and non-treatment)	
Traditional bench terrace	0.5
Bench terrace for uplands	
(1) Good quality	0.04
(2) Medium quality	0.2
(3) Fair to bad quality	0.4
Terrace of irrigated paddy field	0.02
Orchard/Plantation	0.4
Uplands in settlement area (complex: traditional and composite)	0.65
State forest	1
Home settlement area	1
Grass land	1

Source: JICA Study Team

(8) Average Annual Soil Loss from Land Surfaces

The average annual soil loss in the Wonogiri watershed is calculated by use of USLE under the above conditions. It is estimated at about 17.3 million tons/year in the whole Wonogiri watershed. The average annual soil loss in the sub-basin is shown below.

Table 1.4.6 Average Annual Soil Loss and Soil Loss per ha in the Sub-Basin in Wonogiri Watershed

Land use	Sub-Basin								
	Keduang	Tirtomoyo	Temon	Upper Solo	Alang	Ngung-gahan	Wuryan toro	Remnant	Total (1,000 ton/year)
1) Paddy field	12	3	0	1	1	1	0	0	18
2) Home Settlement Area									
- housing yard	961	450	39	211	42	27	18	12	1,761
- Uplands in settlement area	1,797	732	136	588	245	128	108	58	3,792
3) Uplands	1,726	2,911	660	2,403	521	438	197	264	9,120
4) Orchard and Plantation	363	235	52	298	31	25	35	31	1,071
5) Forest	11	0	0	0	0	0	1	2	14
6) State forest									
- forest	4	8	0	0	0	0	0	4	16
- Other use	234	440	85	299	210	52	1	33	1,454
7) Others	4	7	1	7	6	6	0	1	34
Total	**5,112**	**4,786**	**974**	**3,808**	**1,057**	**777**	**360**	**405**	**17,279**
Catchment Area (km^2)	421	231	63	206	169	82	44	28	1,244
Average annual soil loss /ha (ton/ha/year)	**121**	**208**	**156**	**185**	**62**	**94**	**82**	**146**	**139 (average in all basins)**

Source: Results of JICA Survey

Average annual soil loss from the Keduang basin is the largest, followed by Tirtomoyo, Upper Solo and Alang. Average annual soil loss from the other 5 sub-basins is small, showing less than one million tons/year. The Keduang has the highest value of soil loss, in spite of relatively low soil loss/ha, because it has the largest catchment area. Though the basins of the Tirtomoyo and Upper Solo are half of that of the Keduang, they have a higher value of soil loss /year owing to the higher value of soil loss/ha. The annual soil loss in the whole Wonogiri watershed is illustrated below and the sources of soil loss for

each sub-basin will be explained in the section 7.2.1 in Chapter7.

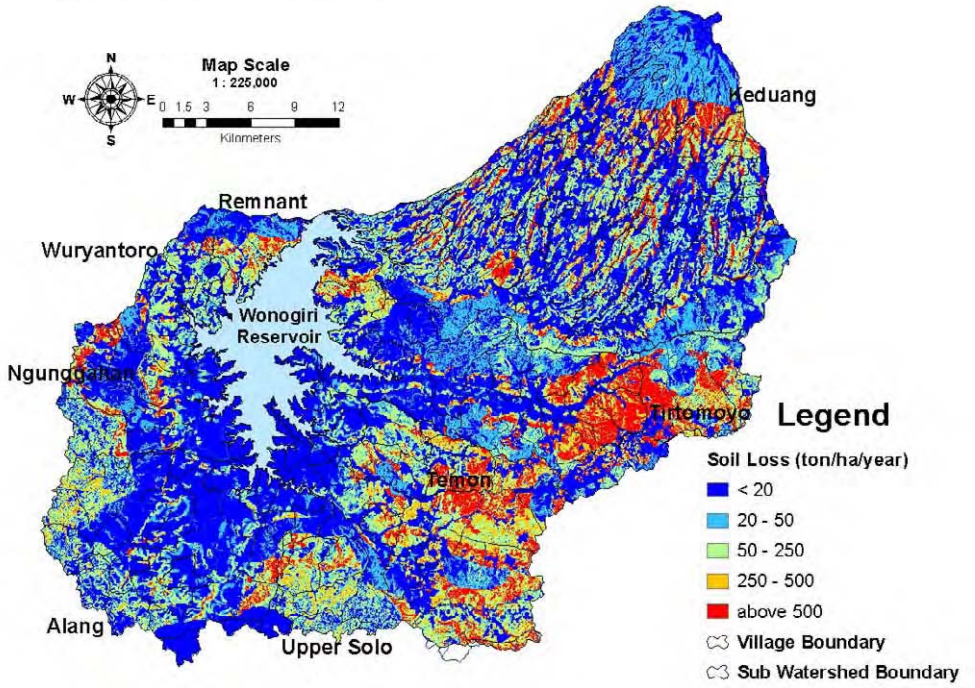


Figure 1.4.2 Annual Average Soil Loss per Hectare in Wonogiri Watershed

As mentioned in Section 4.1, much of the eroded sediment from soil erosion is re-deposited before it enters the Wonogiri reservoir. Sediment yield from the Wonogiri watershed (to the Wonogiri reservoir) is thus estimated by use of the sediment delivery factor. The process for estimating the sediment yield from all erosion sources of the sediment deposits in the Wonogiri reservoir is discussed in the succeeding section below.

1.4.3 Estimate of Annual Sediment Yield to Wonogiri Reservoir

(1) Annual Sediment Yield from Erosion of Gullies, Landslides, Riverbank and Roadside Slopes

Although the specific gravity of sediment source materials from gullies, riverbank and roadside slopes is 2.65 ton /m^3, their bulk densities are generally in the range from 1.2 to 1.8 ton/m^3 because they include both solid grains and voids. On the other hand, the average bulk density of the Wonogiri Reservoir sediment is 1.064 ton/m^3 which is the dry weight per unit volume of the bulk sediment deposited in the Wonogiri Reservoir. Under the Study, the bulk density of source materials is assumed to be 1.6 ton /m^3 with a void ratio of 40%.

The estimation results are summarized below.

Table 1.4.7 Annual Wonogiri Sediment Yield by Source

River System	Gully Erosion	Landslide	River Bank	Roadside Slope	Surface Soil Erosion	Gross Annual Sediment Yeild from Watershed
	(m^3/year)	(m^3/year))	(m^3/year)	(m^3/year)	(m^3/year)	(m^3/year)
Keduang	67,880	2,930	9,780	3,690	1,134,300	1,218,580
Tirtomoyo	90	11,730	19,760	2,480	469,700	503,760
Temon	30	0	11,350	600	61,000	72,980
Solo	220	440	11,040	1,990	591,300	604,990
Alang	7,330	0	66,620	730	326,600	401,280
Others	0	0	11,850	1,170	363,900	376,920
TOTAL	**75,550**	**15,100**	**130,400**	**10,660**	**2,946,800**	**3,178,510**
(%)	**2.4**	**0.5**	**4.1**	**0.3**	**92.7**	**100**

Source: JICA Study Team

As seen on the right, the dominant erosion source is the soil erosion from the land surface. Its volume is 93% of the total, while total sediment yield from other sources is only 7%. Excluding soil erosion from land surface, bank erosion is predominant at 55% of total sediment yield which excludes soil erosion. Gully erosion follows with 33% and road side slope erosion is only 5%.

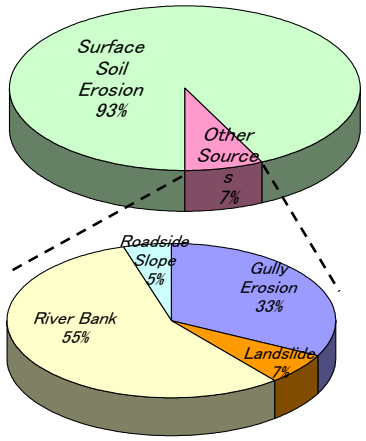


Figure 1.4.3 Percentage of Annual Wonogiri Sediment Yield by Source

1.4.4 Sediment Delivery Ratio

Much of the eroded sediment from a distant source will typically encounter more opportunities for re-deposition before the watershed outlet. The ration between the erosion rate and sediment yield is the "sediment delivery ratio (SDR)". Dr. Gregory L. Morris and Dr. Jiahua Fan (1997)[7] have described the sediment delivery ratio as follows:

> *"The sediment delivery ratio cannot be measured directly because gross erosion is never measured in a watershed; erosion rate is extrapolated from smaller plots or computed from modeling. Thus, the delivery ratio is actually the ratio of measured yield to the estimated erosion rate based on USLE or some other erosion prediction methodology. Delivery ratios much greater than unity have been reported by some researchers, and reflect the inability of erosion prediction models to account for all the erosion processes upstream of the point of yield measurement."*

Dr. Boyce (1975) stated that the relationship of sediment yield to drainage area usually differs from the sediment delivery to drainage area relationship by only a constant, and summarized several relationships for the sediment delivery ration, as quoted below.

[7] Gregory L. Morris, and Jiahua Fan, 1997, "Reservoir Sedimentation handbook", pp. 6.29-6.33

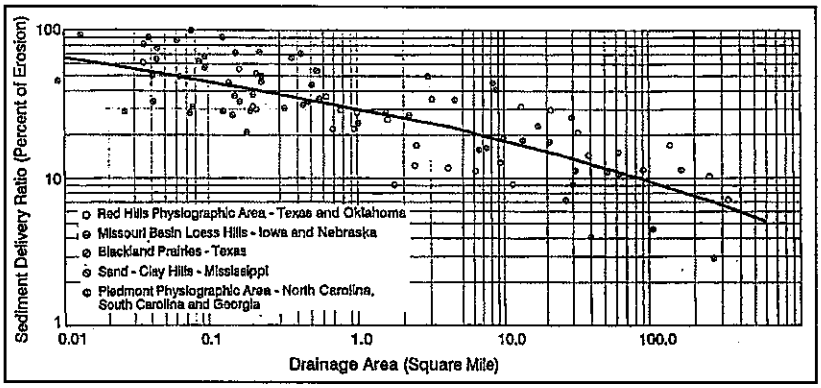


Figure 1.4.4 Sediment Delivery Ratios from Selected Areas in the United States (Boyce, 1975), from Reservoir Sedimentation Handbook

Under the Study, the SDR for soil erosion from land surface was extrapolated by using the measured sedimentation volume in the Wonogiri reservoir which was directly surveyed in the Study. SDR for each tributary are summarized in the figure and table below.

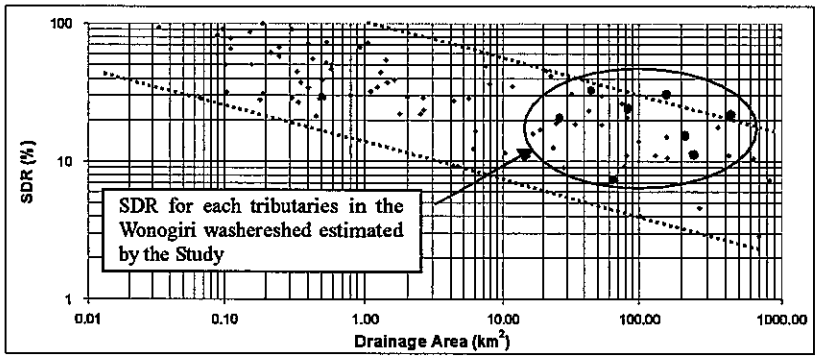


Figure 1.4.5 Sediment Delivery Ratios in the Wonogiri Watershed

Table 1.4.8 Sediment Yield and Sediment Delivery Ratio in Wonogiri Watershed

River System	Area	Sediment Yield	from Land Surface			Other Sources			Gross Annual Sediment Yeild from Watershed
			Annual Soil Erosion	Annual Sediment Yeild	Sediment Delivery Ratio	Annual Soil Erosion	Annual Sediment Yeild	Sediment Delivery Ratio	
	(km^2)	(mm)	(1,000 m^3)	(1,000 m3)	(%)	(1,000m^3)	(1,000 m^3)	(%)	(MCM)
Keduang	420.95	2.69	4,805	1,134	23.6%	84	84	100%	1.219
Tirtomoyo	230.64	2.04	4,498	470	10.4%	34	34	100%	0.504
Temon	62.59	0.97	915	61	6.7%	12	12	100%	0.073
Upper Solo	205.52	2.88	3,579	591	16.5%	14	14	100%	0.605
Alang	169.38	1.93	993	327	32.9%	75	75	100%	0.401
Ngunggahan	82.39	2.35	730	194	26.6%	7	7	100%	0.201
Wuryantoro	44.11	2.36	338	104	30.7%	4	4	100%	0.108
Remnant	27.67	2.35	380	65	17.1%	2	2	100%	0.068
Total	**1,243.25**	**2.37**	**16,239**	**2,947**	**18.1%**	**230**	**230**	**100%**	**3.18**

Source: JICA Study Team

1.5 Soil Erosion Tests in the Wonogiri Watershed

1.5.1 Objectives of Soil Erosion Tests

The objectives of the soil erosion tests are

- To identify soil loss from the upland field under the present soil conservation practices
- To identify soil loss from the upland field under the proposed soil conservation practices
- To identify soil loss from the upland field under the bare condition
- To assess data collected from the soil erosion tests and to provide basic information for formulating the watershed management plan in the Wonogiri watershed

1.5.2 Location of Test Sites

(1) Location

The four typical upland field sites for soil erosion tests were selected taking into consideration soil conditions, land use, topographic conditions, etc as shown in the following Figure and Table.

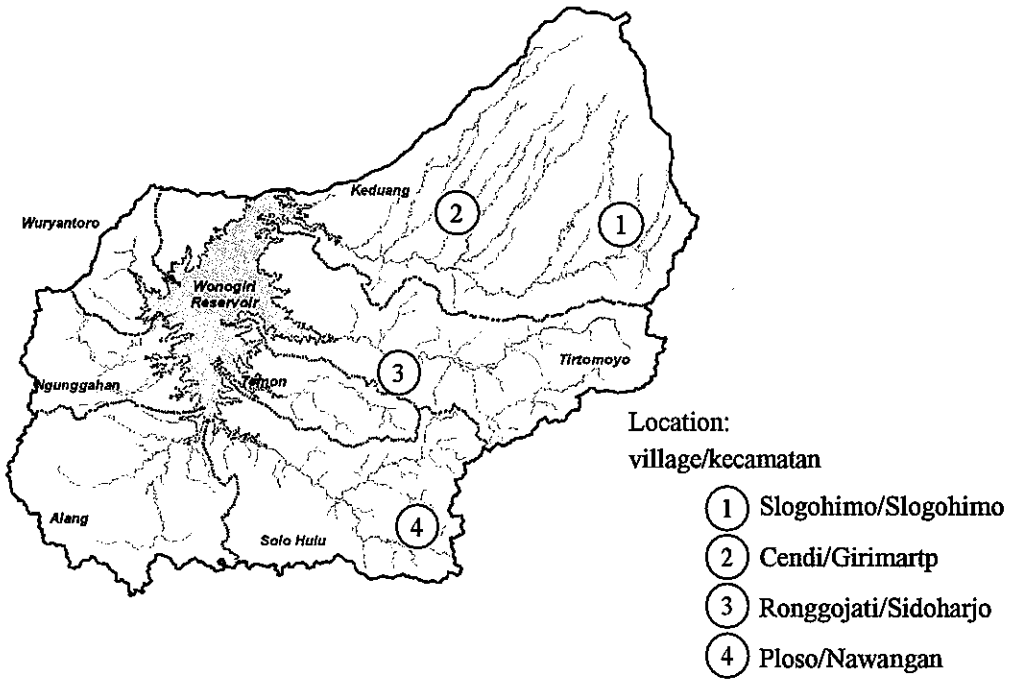


Figure 1.5.1 Location of Test Sites for Measuring Soil Erosion

Table 1.5.1 Location of Test Sites Kecamatan Village

Nos. of test site	Kecamatan	Village
1	Slogohimo	Slogohimo
2	Girimarto	Cendi
3	Sodoharjo	Ronggojati
4	Nawangan	Ploso

Source: JICA Study Team

(2) Present Conditions of Test Sites

The features of the test sites are shown below.

Table 1.5.2 Original Condition of Test Sites

	Test site-1	Test site-2	Test site-3	Test site-4
Land use	Upland field	Upland field	Upland field	Upland field
Original terrace condition	Bench terrace	composite	Bench terrace	Bench terrace
Original vegetation	Maize	Cassava	Maize	Maize
Slope steepness (%)	About 2%	About 4-5%	About 2%	About 1-2%
Soil	Latosol	Latosol	Grumusol	Mediteran soil
Soil texture of surface soil	Clay	Clay	Clay	Clay
Wet density (gr/cm^3)	1.68	1.66	1.58	1.64
Dry density (gr/cm^3)	1.28	1.27	1.12	1.21
Specific gravity	2.59	2.61	2.51	2.51

Source: JICA Study Team

1.5.3 Design of Soil Erosion Tests

(1) Experiment Field and Plot

The experimental fields for soil erosion tests were designed as shown in Figure 1.5.2. The experimental field at each test site consists of 3 experiment plots. Each plot has a rectangular shape with an area of 20 m^2 (5m in length and 4m in width). A concreted water tank that has a storage capacity of 4 m^3 (1m x 2m x 2m) was installed to each plot for measuring soils eroded from the experiment plot.

One rain gauge was installed around each experiment field.

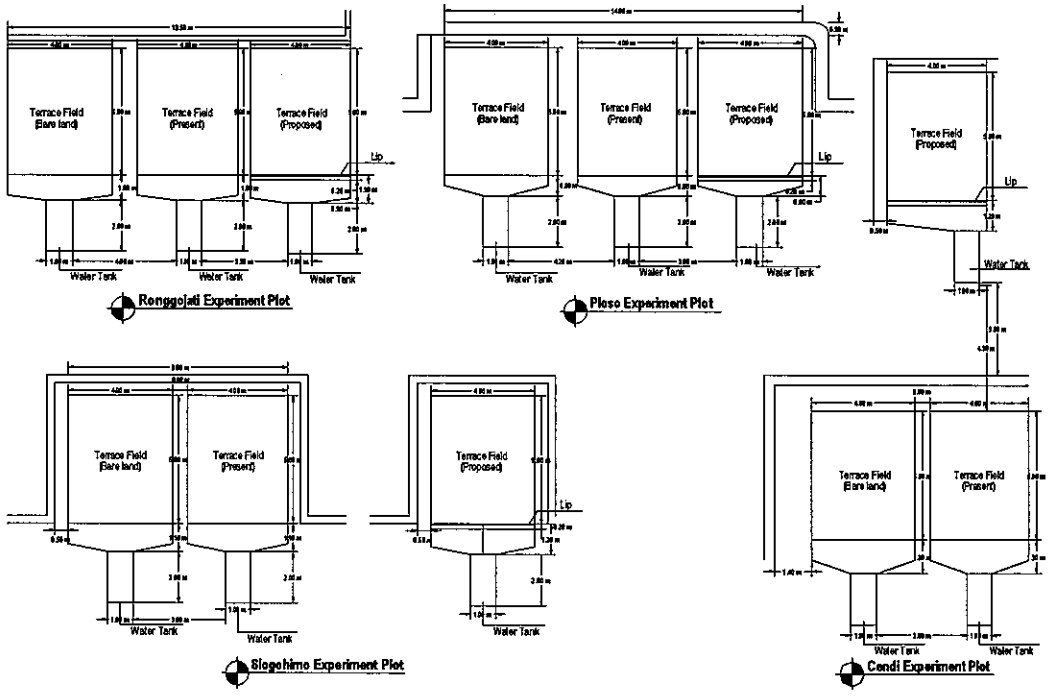


Figure 1.5.2 Experimental Field and Water Tank for Soil Erosion Test

(2) Design for Conservation Practice

Three experiment plots at each experiment field were designed to test soil erosion under three different field conditions such as (1) bared land conditions, (2) present field condition and (3) proposed conditions for soil conservation as follows;

Table 1.5.3 Design of Conservation Practice for 3 Experiment Plots

	Slope of Terrace (%)	Lip and terrace		Start of planting	Kind of crops
		Grass for lip	Grass for terrace riser	1st cropping	
(1) Slogohimo					
i) Bare land	1.8	No	No	1st Jan. 06	Non
ii) Land under present condition	1.8	No	No	1st Jan 06	Maize and cassava
iii) Land with proposed soil conservation means	-0.4	With grass and lip of which height of 30cm and 40cm in width	With grass	1st Jan 06	Maize, soybeans, cassava
(2) Cendi					
i) Bare land	4.2	No	No	1st Jan 06	Non
ii) Land under present condition	4.8	No	No	1st Jan 06	Maize and cassava
iii) Land with proposed soil conservation means	-1.0	With grass and lip of which height of 30cm and 40cm in width	With grass	1st Jan 06	Maize, soybeans and cassava
(3) Ronggojati					
i) Bare land	1.8	No	No	1st Jan 06	Non.
ii) Land under present condition	2.0	No	No	1st Jan 06	Maize and cassava
iii) Land with proposed soil conservation means	-1.0	With grass and lip of which height of 30cm and 40cm in width	With grass	1st Jan 06	Groundnut, maize and cassava
(4) Ploso					
i) Bare land	1.2	No	No	1st Jan 06	non
ii) Land under present condition	2.0	No	No	1st Jan 06	Maize, cassava
iii) Land with proposed soil conservation means	-0.4	With grass and lip of which height of 30cm and 40cm in width	With grass	5th Jan 06	Maize, Soybeans and cassava

Source: JICA Study Team

(3) Design for Farming Practice

Design of farming practice of the present and proposed conditions are shown as following Table.

Table 1.5.4 Design for Farming Practice

	Dolomit	Compost ($kg/20m^2$)	Urea ($gr/20m^2$)	TSP ($gr/20m^2$)	Kcl ($g/20m^2$)	Planting density	Seeding rate	Name of variety
(1)Slogohimo								
i) Present*		5 $kg/20m^2$						
maize			600g/$20m^2$	150g/$20m^2$	150 g/$20m^2$	70x70cm	2seed/hill	BIS2
cassava			-	-	-	140x100cm	1stick/hill	Local
ii)Proposed**		5 $kg/20m^2$	-	-	-			
maize			400g/$20m^2$	200 g/$20m^2$	200 g/$20m^2$	80x40 cm	2seed/hill	BIS2
soybean			12.5g/2.5m^2	25g/2.5m^2	12.5g/2.5m^2	25x20cm	2seed/hill	Lokon
cassava			-	-	-	160x100cm	1stick/hill	Local
Lip grass			-	-	-	25x25xcm		Gajaha
Riser grass						25x25cm		B.B
(2)Cendi								
i) Present*	2kg/20 m^2	10kg/$20m^2$	-	-	-			
maize			400g/$20m^2$	200g/$20m^2$	200g/$20m^2$	80x40cm	2seed/hill	BIS2
cassava			-	-	-	160x120cm	1stick/hill	Local
ii)Proposed**	2kg/$20m^2$	10kg/$20m^2$						
maize			200g/$20m^2$	100	100	80x40	2seed/hill	BIS2
soybean			12.5g/2.5m^2	25g/2.5m^2	12.5g/2.5m^2	25x20cm	2seed/hill	Lokon
cassava		2	-	-	-	160x100cm	1stick/hill	Local
Lip grass			-	-	-	25x25cm	Gajah	Gajah
Riser grass						25x25cm	B.B	B.B
(3)Ronggojati								
i) Present*	2kg/20 m^2	5kg/20 m^2						
maize			400g/$20m^2$	160g/$20m^2$	160g/$20m^2$	90x40cm	2seed/hill	BIS2
cassava			-	-	-	180x110cm	1stick/hill	Local
ii)Proposed**	2kg/20m	10kg/20 m^2	-	-	-			
maize		-	200g/$20m^2$	100g/$20m^2$	100g/$20m^2$	200x40	2seed/hill	BIS2

	Dolomit	Compost ($kg/20m^2$)	Urea ($gr/20m^2$)	TSP ($gr/20m^2$)	Kcl ($g/20m^2$)	Planting density	Seeding rate	Name of variety
groundnuts			$70g/20m^2$	$150g/20m^2$	$70g/20m^2$	25x20cm	2seed/hill	Lokon
cassava			-	-	-	180x100cm	1stick/hill	Local
Lip grass			-	-	-	25x25cm	-	Gajah
Riser grass			-	-	-	25x25cm	-	B.B
(4)Ploso								
i) Present*	$2kg/20m^2$	$5kg/20m^2$						
maize			$600g/20m^2$	$150g/20m^2$	$150g/20m^2$	70x70cm	2seed/hill	BIS2
cassava			-	-	-	140x100cm	1stick/hill	Local
ii) Proposed**	$2kg/20m^2$	$10kg/20m^2$						
maize			$400g/20m^2$	$200g/20m^2$	$200g/20m^2$	80x40	2seed/hill	BIS2
soybeans			$12.5g/2.5m^2$	$25g/2.5m^2$	$12.5g/2.5m^2$	25x20cm	2seed/hill	Lokon
cassava			-	-	-	160x100cm	1stick/hill	Local
Lip grass			-	-	-	25x25cm	-	Gajah
Riser grass			-	-	-	25x25cm	-	B.B

*: Field with present condition
**: Field with proposed farming practice
Source: JICA Study Team

1.5.4 Monitoring of Soil Erosion Test and Results

(1) Monitoring

After the implementation of the experiment fields and water tanks, soil erosion tests were commenced on 1st January 2006 for Slogohimo, Cendi and Ronggojati, and 5th January 2006 for Ploso. Monitoring items are shown below:

- Observation of daily rainfall at 7:00 every morning at each 4 gauging station
- Soils that are stored in the water tanks (12 tanks in total) at 5 day interval were taken and dry soil weight was measured. At the same time, water that is stored in the water tank was measured.
- Height of crops, that is cultivated in the experiment plots, and grass for terrace risers and lips were observed at 5 day interval.

(2) Results of Soil Erosion Tests

The soil erosion tests are now underway. The monitoring results from 1st January to 24th February 2006 were examined. The results of the soil erosion tests are summarized as follows:

Table 1.5.5 Results of Soil Erosion Tests from 1st Jan to 30th Apr 2006

	Slogohimo test site			Girmarto test site			Ronggolati test site			Ploso test site		
Date of Observation	Bare land	Present terrace	Proposed terrace	Bare land	Present terrace	Proposed terrace	Bare land	Present terrace	Proposed terrace	Bare land	Present terrace	Proposed terrace
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Slope of terrace (%)	1.8	1.8	-0.4	4.2	4.8	-1.0	1.8	2.0	-1.0	1.2	2.0	-0.4
Accumulated soil loss (kg/ha/eday)												
1-5 Jan	1,351	2,027	825	3,899	3,352	848	198	327	127	*	*	*
6-10 Jan	7,362	5,407	3,317	1,299	326	348	3,047	3,797	1,145	133	123	0
10-15 Jan	1,966	2,679	429	4,036	1,865	1,078	5,289	4,681	2,987	5,372	4,126	539
16-20 Jan	6,189	7,584	789	10,588	4,045	2,500	8,511	9,796	3,624	6,651	6,652	562
21-25 Jan	1,435	2,050	834	9,518	3,212	2,373	2,918	2,815	339	10,887	8,219	628
26-30 Jan	1,680	4,820	1,456	3,861	3,268	370	5,130	5,963	2,282	2,450	936	624
31Jan-4 Feb	5,325	8,910	1,397	9,425	3,615	360	4,912	3,425	1,199	2,829	2,194	1,002
5 -9 Feb	17,951	27,736	510	13,063	6,596	1,615	17,880	10,117	983	266	524	57
10 -14 Feb	12,534	6,539	124	14,580	3,225	683	11,218	7,523	896	1,964	3,028	54
15-19 Feb	39,410	12,799	579	28,367	10,336	271	6,248	8,919	579	1,799	1,261	317
20 - 24 Feb	12,887	5,147	47	284	115	22	699	1,488	170	7,597	6,691	2,524
25Feb-1Mar	11,060	5,277	80	4,643	1,267	205	5,038	1,488	189	1,048	532	57
2-6Mar	3,237	2,311	233	7,040	2,302	255	4,846	1,618	228	1,129	1,067	120
7-11Mar	5,232	2,455	229	0	0	0	2,020	272	247	0	0	0
12-16Mar	653	194	59	1,307	201	49	113	91	53	2,555	739	47
17-21Mar	3,640	2,436	52	5,550	1,383	185	1,138	43	23	3,487	2,148	177
22-26Mar	578	369	254	10,572	3,042	702	0	0	0	0	0	0
27-31Mar	178	43	35	419	163	36	57	47	0	960	624	231
1-5 Apr	11,013	2,038	88	1,396	413	102	4,050	524	225	3,531	2,891	216
6-10 Apr	14,621	2,766	67	9,386	2,081	214	4,284	1,254	17	1,625	1,337	178
11-15 Apr	16,299	3,624	134	53,075	12,276	836	13,866	8,434	225	6,673	2,874	322
16-20 Apr	11,395	7,660	348	27,232	18,132	1,636	2,112	1,636	84	4,574	2,966	135
21-25 Apr	7,066	2,042	41	2,949	413	130	0	0	0	7,407	3,646	297
26-30 Apr	0	0	0	0	0	0	0	0	0	0	0	0
Total (kg/ha)	193,062	116,913	11,927	222,489	81,628	14,818	103,574	74,258	15,622	72,937	52,578	8,087
Rate=(1)/(3) &(2)/(3)	16.2	9.8	1.0	15.0	5.5	1.0	6.6	4.8	1.0	9.0	6.5	1.0
rain fall (mm) and water level in tank (cm)***	raifall (mm)	water level in tank (cm)		raifall (mm)	water level in tank (mm)		raifall (mm)	water level in tank (mm)		raifall (mm)	water level in tank (mm)	
1-5 Jan	62	18	24	20	79	34	28	24	29	14	10	11	39	*	*	*
6-10 Jan	82	77	88	79	37	20	18	20	32	30	25	27	8	1	2	0
10-15 Jan	31	21	23	22	38	22	21	22	83	75	73	78	57	33	55	12
16-20 Jan	64	55	66	63	50	35	25	26	57	45	48	38	37	8	10	8
21-25 Jan	41	2	20	23	74	52	43	38	71	6	35	21	103	66	98	56
26-30 Jan	31	15	16	16	47	29	20	23	55	37	35	26	42	28	34	29
31Jan-4 Feb	74	90	92	89	103	39	29	28	108	79	77	67	74	58	75	45
5 feb-9 Feb	146	157	170	105	63	102	101	93	126	117	107	92	13	7	7	2
10 -14 Feb	63	60	64	68	44	29	29	25	68	67	63	55	21	15	18	11
15 -19 Feb	136	133	180	73	99	93	87	69	35	31	15	10	25	13	18	8
20 -24 Feb	31	58	67	50	15	6	6	5	70	55	42	26	111	100	112	98
25Feb-1Mar	61	44	51	42	51	34	33	21	62	46	27	17	82	58	65	35
2-6Mar	47	20	30	29	65	45	44	33	55	29	25	17	32	28	29	11
7-11Mar	15	11	15	23	1	0	0	0	10	5	6	1	2	0	0	0
12-16Mar	28	8	9	15	35	11	10	7	10	1	2	1	36	22	19	9
17-21Mar	47	29	31	25	46	35	29	16	34	11	5	5	65	44	22	29
22-26Mar	22	14	14	22	44	47	40	27	5	0	1	0	2	0	0	0
27-31Mar	20	4	5	11	14	4	5	4	10	1	2	2	34	25	23	13
1-5 Apr	60	47	40	25	37	19	14	8	70	32	16	15	79	64	64	42
6-10 Apr	77	82	75	35	63	57	51	30	32	23	18	10	37	0	23	16
11-15 Apr	73	65	42	45	169	187	176	124	63	40	34	27	70	56	58	39
16-20 Apr	116	133	112	83	151	155	174	132	39	20	16	10	45	39	42	25
21-25 Apr	32	33	28	32	21	16	20	10	9	1	1	1	55	41	47	33
26-30 Apr	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Total rainfall (mm)	1,358				1,346				1,132				1,070			
Accumulated height (cm)		1,176	1,262	995		1,071	1,003	785		765	683	557		706	821	521
Runoff coefficient (%)***		87	93	73		80	75	58		68	60	49		66	77	49

*: Observation of Ploso site was started on 6th January 2006.
**:Accumulated rainfall and water height in tank for 5days
***: Rate of total rainfall stored in the tanks per total rainfall

Source: JICA Study Team

It may be concluded from the above table that the following facts are realized.

- The proposed terrace is very effective for soil erosion control. Soil loss from the proposed terrace is 21% (1/4.8)-10% (1/9.8) of that from the present terrace land and 12% (1/6.6)-6% (1/16.2) of that from the terrace with bare land condition.
- There are several overflows from terrace field into terrace riser in case of present and bare land conditions. Proper preparation of lips seriously contributes to an important function of soil loss control.
- Runoff coefficient of the proposed terrace field is lower than that of case of present and bare land conditions. It suggests that inward slope gradient in the proposed terrace should enforce rainfall on the terrace to penetrate into soils and make runoff coefficient smaller. As a result, soil erosion from the terrace field is prevented.
- Rill erosion on the terrace riser may become one of the important sources of soil loss.

The conditions of 4 soil erosion test sites are shown in the Collection of Photographs, Volume-VI.

CHAPTER 2 PLANNING FOR WATERSHED CONSERVATION AND MANAGEMENT

2.1 Lessons Learned and Need of Water Conservation

2.1.1 Lessons Learned and Key Issues

The Government performed Re-greening program during the period of 1960'. Afterwards UNDP/FAO conducted soil erosion control project in 1970' in the Solo river basin containing the Wonogiri watershed area. Then, IBRD performed watershed management project for the Wonogiri watershed area on a large scale. The past efforts for the watershed conservation in the Wonogiri watershed area are represented by 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 watershed conservation were continued in a limited scale by utilizing district, provincial and national budget. In 2003, GERHAN scheduled for the period from 2003 to 2007 was lunched and activities for the conservation in the watershed area have been restored to a substantial degree. The lessons learned from the past watershed conservation efforts in the watershed area are described in Table 2.1.1.

The key issues to be duly addressed in the formulation of the conservation measures in the Wonogiri watershed area, which are identified through the study on the present conditions/problems and causes and lessons learned are enumerated as follows;

(1) Technical Issues

- The 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 envisaged through integrated and collaborated activities for watershed conservation.
- Emphasis on agricultural approaches should duly be considered as agricultural lands occupying majority of the watershed area and farmers accounting for almost all target groups of conservation measures. Most causes of erosion are attributed to agricultural activities and most of erosion control measures are also closely related with them.
- An introduction of tree crops presents effective measures for soil erosion. However, types of agro-forestry should be determined based on comprehensive study on natural and socio-economic conditions since there will be certain competition between forestry and agricultural uses of land.
- Conservation techniques to be introduced should be readily accepted by the farmers (practitioners)
- Without sufficient understanding and agreement of practitioners, farmers/farmer groups in many cases, on the meanings, benefits and other details of conservation measures, anticipated results will not be resulted.
- It is prerequisite that a scrupulous technical conservation means for the watershed project should be approached to each watershed 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 has been few successful watershed conservation projects which were performed under a full top-down management and/or use of inflexible prescriptions poorly adapted to local conditions since the projects did not formulated without

reflection on real needs of farmers (practitioners) and project expenditures to be spread among villages and communities in the project area was small.

- Since the area of the watershed conservation projects for the river basins are generally very huge and cover with many kecamatans and the communities (villages), water conservation project based on river basins without consideration of institutional coordination often have encountered administrative problems concerning understanding and agreement among farmers (practitioners) for implementation of the projects. It is very important that the watershed conservation projects should be carried out not by the river basin-based development but by community-based development.
- Grant aid in the terrace rehabilitation projects has resulted in a detrimental change in social behavior in 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.
- Monitoring of performances of the programs implemented was seldom practiced in the past. Then problems and constraints encountered in the project implementation and management were not identified and no reflected for improvement of effective project implementation and sustainable operation and maintenance of the watershed management.

(3) Socio-institutional Issues

- Link between poverty, aging of farmers, and poor management of dry farm land left being less attended due to farmers seeking for off-farm income in the cities should be addressed to an extent possible. Therefore, packages of conservation measures and improved agricultural practices must provide adequate and immediate and long term financial gains to farmers for ensuring positive participation of 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 and PKL, are very important.
- The decentralization programs have weaken the effective technical transfer with agriculture and watershed conservation that had been run through the central government to the local governments (province, Kabpaten, Kecamatan and villages), and the institutional improvement on technical transfer should be required. Moreover, communication among the related authorities concerned in charge of the watershed conservation activities is weak, of which improvement becomes one of the most important factors for the smooth implementation of the projects.

2.1.2 Needs of Local Communities

Village assessment based on the participatory rural appraisal (PRA) has been implemented in the selected 24 villages during Jun – Sep 2005. In succession, village workshops were carried out for formulation of village action plan for soil conservation in Nov and Dec 2005. The needs analysis as mentioned below was made through the village assessments and village workshops.

(1) Need for soil conservation

The needs analyses result of the village action plan are summarized below.

Table 2.1.2 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 of trees
Institutional Issues	Low capacity of existing groups	13	
	Luck 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.

Above table indicates that 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 yield as well as decrease of trees caused negative impacts to water resource. Therefore it could be judged that villages have needs for soil conservation and re-planting.

(2) Priority of countermeasures for soil erosion

According to the analysis result of village action plan, most of villages showed higher priority on civil works such as small gully plugs and improvement of drainage channels for the soil conservation. As next priority, trees planting and terraces rehabilitation are selected. People noted that civil works need more government assistance, since the more budget is required. Therefore, there is some deference 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 become reluctant to improve soil condition such as terracing through labor intensive works. Moreover, low economic condition causes illegal logging in the state forest. The survey team understood that one of the most important aspects in the soil conservation program is economic uplift.

(4) People understanding of soil erosions

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

Table 2.1.3 Nos. of Erosion Location in Surveyed Villages

	Rill (Sheet) Erosion	Gully Erosion	Landslides	River Bank 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 survey villages prepared soil erosion maps and proposed countermeasures by

themselves. As results, 532 erosion locations in total were identified by the people. On the other hand, there is no correlation between numbers of erosion location specified by the village and annual sedimentation yield estimated by the JICA Study Team. It indicates that people could not compare to erosion damage in the other villages and assess the soil erosion damage.

(5) People's view of soil erosion program

No village noted that the purpose of soil erosion program is to keep the storage capacity of Wonogiri dam. They understand that the program should be to maintain the fertility of their agriculture land. On the other hand, the concerns of the people to the dam are very low, since people receive little benefit from the dam.

(6) State forest (Hutan Negara) vs Peoples Forests (Hutan Rakyat)

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

(7) Share of the responsibility

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

Table 2.1.4 Summary of Needed Assistance 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 will be made by people with the minimum assistance. In addition, people expressed that they will carry out socialization program for each hamlet, establishment of the implementation committee, preparation of the detailed proposal.

(8) Activities of existing organizations

Peoples feel that seasonal migration weaken existing organizations, since 30-60% of households have family members who make migration. Local NGO also reported that social solidarity in working together as self reliant activities for the village has been upset as a result of grant aid given by the past projects.

(9) Activities of supporting services

Peoples feel that the extension staffs of forest or agriculture as well as local NGO are relatively far from them, since majority of extension staff and NGO comes to the community only when the project was implemented. On the other hand, extension staff

noted that they are very busy for the project management due to limited number of staff.

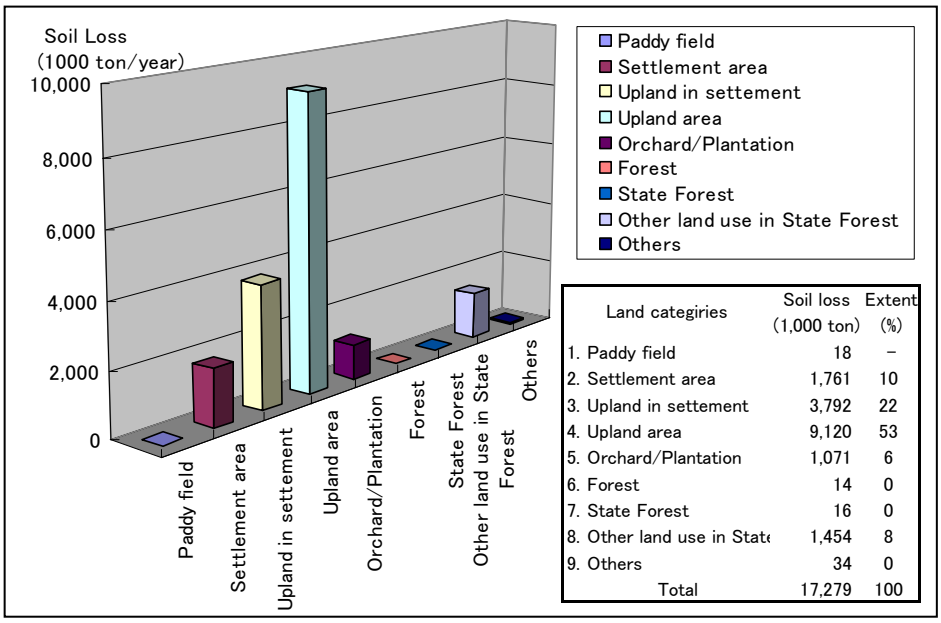
2.2 Formulation of Watershed Conservation Plan

2.2.1 Basic Strategies for Watershed Conservation

(1) Detailed Soil Erosion Sources and Subject Areas for Watershed Conservation

As explained in chapter 4, the main soil erosion sources and soil loss from the Wonogiri watershed are the land surface, occupying about 93% of the total soil loss from the watershed and remaining 7% are soil loss from off-farms such as landslide, riverside soil erosion, roadside erosion and gully erosions

The total annual average soil loss from the Wonogiri watershed is estimated at about 17.3 million tons, mainly consisting of i) 9.1million tons or 53% of total soil loss from upland fields, ii) 3.8 million tons or 22% from settlement areas under upland field condition, iii) 1.8million tons or 10% from settlement areas, and iv) 1.5million tons or 8% from the State Forest. These four main soil erosion sources cover over 90% of the total soil loss from the Wonogiri watershed as shown in the following figure.



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 State	1,454	8
9. Others	34	0
Total	17,279	100

Source: JICA Study Team

Figure 2.2.1 Annual Average Soil Loss of Landuse in Wonogiri Catchment

Details on the annual average soil loss, average soil loss per ha (ton/ha/year) are shown in Tables 2.2.1-2.2.3.

On the other hand, soil loss from other land use categories of (1) paddy field, (2) orchard/plantation area under tree/tree crops cover (people's forest, orchard, estate crops area), (3) others and (4) forest in the State Forest Corporation are estimated to be limited to an acceptable scale.

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

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 watershed.

The subject areas for the Wonogiri watershed conservation under the present study are shown below.

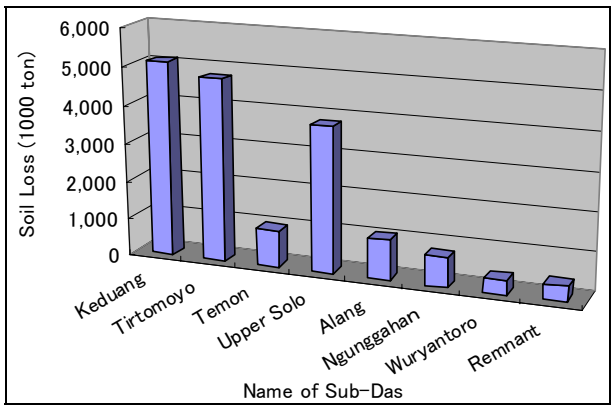
Table 2.2.4 Subject Areas of Watershed Conservation under the Present Study

Subject Area	Remarks
Upland Fields	Occupy about 1/3 of the watershed area from low lying area to steep sloping area
Settlement areas under upland field condition	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	
Paddy Fields	Best sustainable land use in terms of soil conservation
Orchard/plantation under Tree/Tree Crop	Peoples forest/orchard/plantation; limited in extent
Estate forest	Estate forest lands are owned by the Estate Forest Corporation and their reforestation was programmed.
Others	Limited in extent

Source: JICA Study Team

The area extents of (1) upland field, (2) upland field in settlement area and (3) 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 watershed.

Regarding to sub-basin basis in the Wonogiri watershed, annual average soil loss in the Wonogiri Watershed is summarized below. Three watersheds such as Keduang, Tirtomoyo and Upper Solo are the main producer of soil loss in the Wonogiri watershed and occupy about 80% of the total soil loss in the whole basin.



Source: JICA Study Team

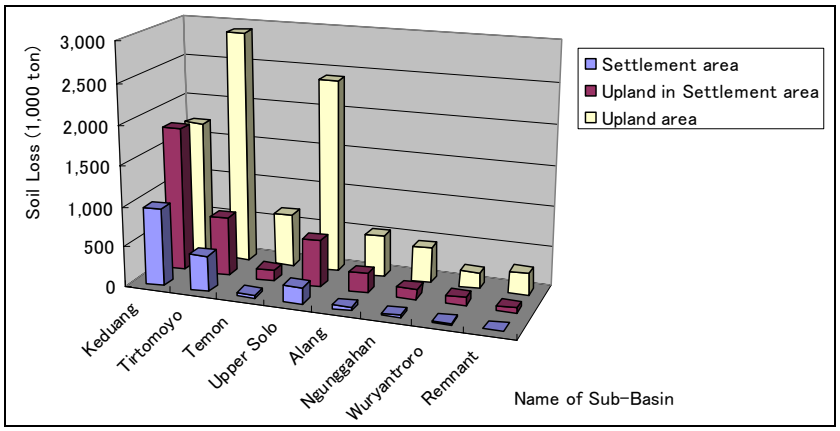
Figure2.2.2 Annual Average Soil Loss from Sub-Basins

Table 2.2.5 Annual Average Soil Loss (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

And the pattern of annual average soil loss from i) upland field, ii) settlement area and iii) settlement area under upland field condition and upland area is very different among sub-basins as shown below; The main erosion sources of the Tirtomoyo and Upper Solo sub-basins are upland field and the Keduang not upland field but settlement area under upland field condition and home yards in the 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.



Source: JICA Study Team

Figure 2.2.3 Average Soil Loss of Sub-das from the 3 Subjective Area Based on Landuse (1,000 ton)

Table 2.2.6 Annual Average Soil Loss from 3 Subject Area in Sub-basin (1,000 ton/year)

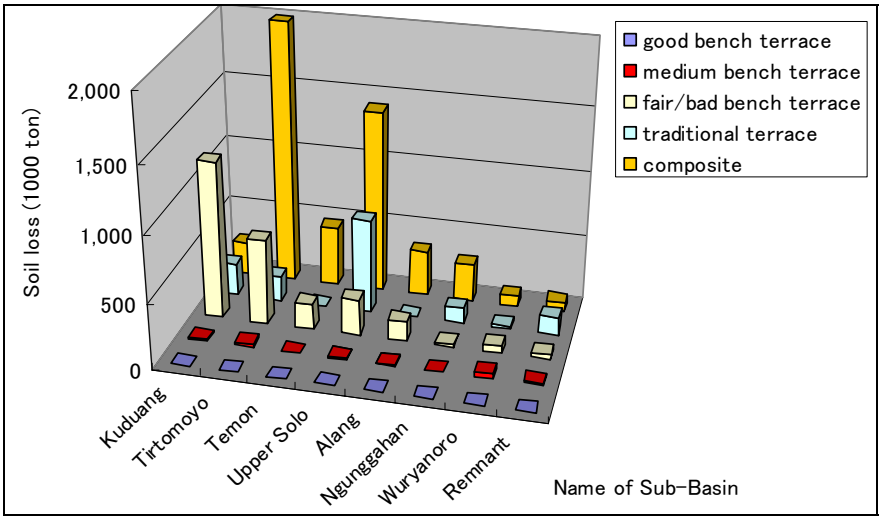
Name of sub-das	Settlement area	Upland in settlement	Upland	Total (ha)	Extent (%)
Keduang	961	1,797	1,726	4,484	31
Tirtomoyo	450	732	2,911	4,093	28
Temon	39	136	660	835	6
Upper Solo	211	588	2,403	3,202	22
Alang	42	245	521	808	6
Ngunggahan	27	128	438	593	4
Wuryantoro	18	108	197	323	2
Remnant	12	58	264	334	2
Total	1,760	3,792	9,120	14,672	100

Source: JICA Study Team

Detail information of annual average soil loss, area and soil loss per ha (ton/ha/year) on sub-basin level are shown in Tables 2.2.7 – 2.2.9.

Furthermore the annual average soil loss of upland field, that is the highest soil loss producer or 53% of the total average soil loss of the Wonogiri watershed, is quite different depending on the sub-basins. Upland fields 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 2.2.4. The annual average soil loss and subjective areas are shown in Tables 2.2.10 and 2.2.11.

Annual average soil loss from composite area with association of no terrace lands and ridge terrace lands occupies over 50% of the total upland, of which about 70% comes from the two sub-basins of the Tirtomoyo and the Upper Solo, while the Keduang not from composite land but from the bench terrace with fair/poor maintenance condition. Details information is shown in Tables 2.2.12 – 2.2.14.



Source: JICA Study Team

Figure 2.2.4 Annual Average Soil Loss from Upland Field (1000 ton/year) in Sub-basin without State forest area

Table 2.2.10 Average Annual Soil Loss from Upland area in Sub-das (1,000 ton/year)

Name of Sub-das	Bench Terrace			Traditional terrace	Composites	Total soil loss	Extent (%)
	Good	Medium	Fair/bad				
Keduang	0	15	1,205	252	254	1,726	19
Tirtomoyo	1	25	653	195	2037	2,911	32
Temon	0	0	199	0	461	660	7
Upper Solo	1	8	273	722	1399	2,403	26
Alang	3	9	150	7	351	520	6
Ngunggahan	1	5	22	119	292	439	5
Wuryantoro	1	40	56	21	79	197	2
Remnant	0	16	36	138	73	263	3
	7	118	2,594	1,454	4946	9,119	100

Source: JICA Study Team

Table 2.2.11 Subjective Area for Upland Area in Sub-das (ha)

Name of Sub-das	Bench Terrace			Traditional terrace	Composites	Total (ha)	Extent (%)
	Good	Medium	Fair/bad				
Keduang	0	184	7,002	772	857	8,815	22
Tirtomoyo	17	206	4,142	527	4094	8,986	23
Temon	0	0	1,137	1	800	1,938	5
Upper Solo	131	253	1,410	2,198	3880	7,872	20
Alang	639	326	3,231	256	2567	7,019	18
Ngunggahan	155	79	167	620	1257	2,278	6
Wuryantoro	40	547	650	154	273	1,664	4
Remnant	0	201	123	512	352	1,188	3
	982	1,796	17,862	5,040	14080	39,760	100

Source: JICA Study Team

The above results on the subject area for watershed conservation in the Wonogiri 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.

(2) Basic Development Concept

The annual average soil loss from the Wonogiri watershed is very huge and is estimated at 17.3million tons per year of which 3.2 million tons/year deposit in the Wonogiri reservoir. 93% of annual sediment yield on the reservoir comes from agricultural lands and the remaining come from off-farm sediment from gully erosion, landslides, riverbank erosion and roadside slope erosion. As mentioned previously, the main soil loss erosion sources are from uplands, uplands in the settlement areas and the fringe of the yards in the settlement areas and the most urgent objective is soil erosion control for these areas.

The results of the village assessment survey indicated that the farmers in the Wonogiri watershed understand that soil erosion brings about decrease of soil fertility and causes reduction of crop yields, and also interest in soil conservation. Also the farmers have intention to increase agricultural income through watershed conservation.

In order to realize the urgent objective, this watershed conservation project should be formulated from the view point of 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 the watershed conservation in the Wonogiri watershed is set as follows;

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

- The soils in Wonogiri watershed are very fine and it is very difficult to effectively trap soils eroded from the watershed by the implementation of the large scale civil structures such as sabo dams. Therefore it is not expected that soil erosion control function based on such watershed conservation measures can not be obtained economically. In principle, the large scale civil works are not adopted in this Study.
- As the soil erosion tests in the Wonogiri watershed that were conducted in this study showed that 'improved bench terrace' was very effective for soil erosion. Then, introduction of such improved bench terraces as well as vegetative conservation measures is to be made.

- Improvement of the existing bench terraces, construction of improved bench terrace for the areas of uplands without terraces, reinforcement of prevention function against soil erosion for bench terraces through grassing for 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 next generation of farmers with resources of another agricultural incomes.
- Introduction of specific improved technology on soil and water conservation measures, cropping pattern, farming practices for increasing crop yields based on the present conditions, land suitability and potential, and
- Reinforcement of soil erosion prevention against the fringe of the yard by construction of hedge row and side ditches.

2) Basic Development Concept from the socio-institutional viewpoint

- In spite of a top-down conservation management system, a community-based bottom-up conservation management system that fully reflects conservation-oriented awareness of the farmers in the project area will be basically adopted.
- Community will take a leading role for the watershed conservation from the stage of planning to through the stage of monitoring stage after project construction through the stage of project constriction.
- Organization setting up at village level establishment of an implementation committee at village level with transparency of all the process relevant to the project implementation
- An adequate coordination organization will be made to execute smooth collaborative activities of all stakeholders, communities and implementing agency for the implementation of the watershed conservation project.
- Proper incentives to beneficiary farmers will be provided to increase people's motivation such as partial subsidy to labor and material costs and training program. Also the small scale village grant fund system will be established.
- Information dissemination of importance of watershed and Wonogiri dam to the local people, especially young generation

2.2.2 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 effects of both measures.
- Conservation measures should be (readily) accepted by farmers (practitioners) and should be measures which are not sophisticated, easy to introduce, 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 currently indicate adaptability of vegetation to the physical and socio-economic environments of the watershed area.
- Formulation of agricultural measures taken into consideration of principles of water erosion control: to reduce raindrop impact on soil, to reduce runoff volume/velocity

and to increase soil's resistance to erosion,

- Agricultural approaches should envisage: i) to improve agricultural productivity and increase farm income, ii) to improve soil fertility and physical properties and iii) cropping system improvement examined 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 and 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 grantee the transparency of the project process, implementation committee should be organized at village level. The member of implementation committee should be selected in the transparent manners. The major role of the committee is to coordinate with executing agency, create the consensus amongst village people and to monitor all the process from the planning to the post-construction. At least, representatives of hamlet should involve into the committee member, since the activities will be made at hamlet basis. The responsibility as well as detailed member constitution should be discussed in the workshop.
- People should be aggressively involved into all the process from planning to project monitoring. Executing agency should facilitate (not force) the consensus with local people for the project. In that sense, the planning stage is most important, since people would like to decide content of the project by themselves. As results of such efforts, people involvement will enhance into the project.
- The result of village survey such as implementation of PRA and workshops indicates the necessity of qualified facilitator. Therefore, local NGO should be attached as facilitator for all the process of the project. Considering the present complains to the local NGOs in the surveyed village, the implementation committee should be involved in the selection of local NGO process.
- The result of village assessment indicated that village needs the technical assistance to assess the soil erosion. In addition, further assistance for topographic survey, design and cost estimation will be required. Therefore, the consultant should be attached.
- Demonstration plots for improved terrace with proper vegetation and drainage system should be established in appropriate numbers of villages, so that people can visually understand the impact of improved terrace. Those demonstration plots will contribute to the project sustainability through well understandings of soil conservation effect caused by the improved terrace.
- Considering low benefit in the short run from agriculture improvement in the project, the proper incentive to the beneficiaries should be introduced, although the some negative impacts caused by heavy subsidy (100% subsidy of labor cost) were identified in the past project. The proposed incentives are: i) land registration at free of charge in the terrace rehabilitation or formulation area, ii) subsidy of labor charge at the ratio of 25-50%, iii) subsidy to the construction materials and agricultural inputs, and iv) training program for people's capacity building on new agricultural

techniques.

- The result of village survey indicates high needs of off-farm income. The soil conservation is closely related to the on-farm income such as annual crop and tree crop productions. To increase the incentive of maintenance work for the project facilities, enhancement of future off-farm income such as agro-processing and wood processing should be considered. In the project period, the training program for future processing work will be main target, since no production is expected. But, future return and incentive of maintenance work will be expected through such training programs.
- The components for soil conservation will be limited to structure construction against soil erosion, tree planting, and agriculture measures. Those components will be financed by the project. However, the village action plans indicate various needs such as water resources improvement, marketing development, road access improvement etc. For such needs, it is proposed to establish village grant fund under decision and financial management of the implementation committee. Even though amount of village fund is limited, the motivation of people will dramatically increase, since people can decide how to use the fund.
- Importance of watershed protection and Wonogiri dam should be disseminated to the village people. Therefore, pamphlet, poster and village seminar to young generation should be included in the project. To increase the project sustainability in the long term, those understandings, especially to the young generation, is essential.
- Even though the state forest company is implementing the forest rehabilitation program, the explanation to and discussion with local people are required. Therefore, coordination body amongst implementation committee/village administration and state forest company should be established in the project.

2.2.3 Formulation of Watershed Conservation Measures

The basic directions applied for the formulation of watershed conservation in the present study have been contemplated 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 directions for the formulation of counter measures have been set for: i) proposed land use/agro-forestry development (slope classes and proportion of annual crops and 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 shown in Table 2.2.15 and as discussed below.

(1) Slope Classes and Land Use

The basic direction 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 labor burden in future farming activities through the expansion of fruit/estate crops cultivation to meet gradual aging of farming communities and tendency for seeking non-farm job opportunities of next generation.

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

Table 2.2.16 Slope Classes and Proposed Land Use

Slope Class	Proposed Land Use		Agro-forestry Features
	Annual Crops	Perennial Crops/Trees	
0 - 8%	90%	10%	Mixture of tree crops and trees depending on farmers preference
8 - 15 %	75 %	25 %	
15 - 25 %	50 %	50 %	Mixture of tree crops and trees under grown with medical crops etc.
25 % - 40 %	25 %	75 %	
> 40 %	-	100 %	

Source: JICA Study Team

(2) Slope Classes and Terrace Types

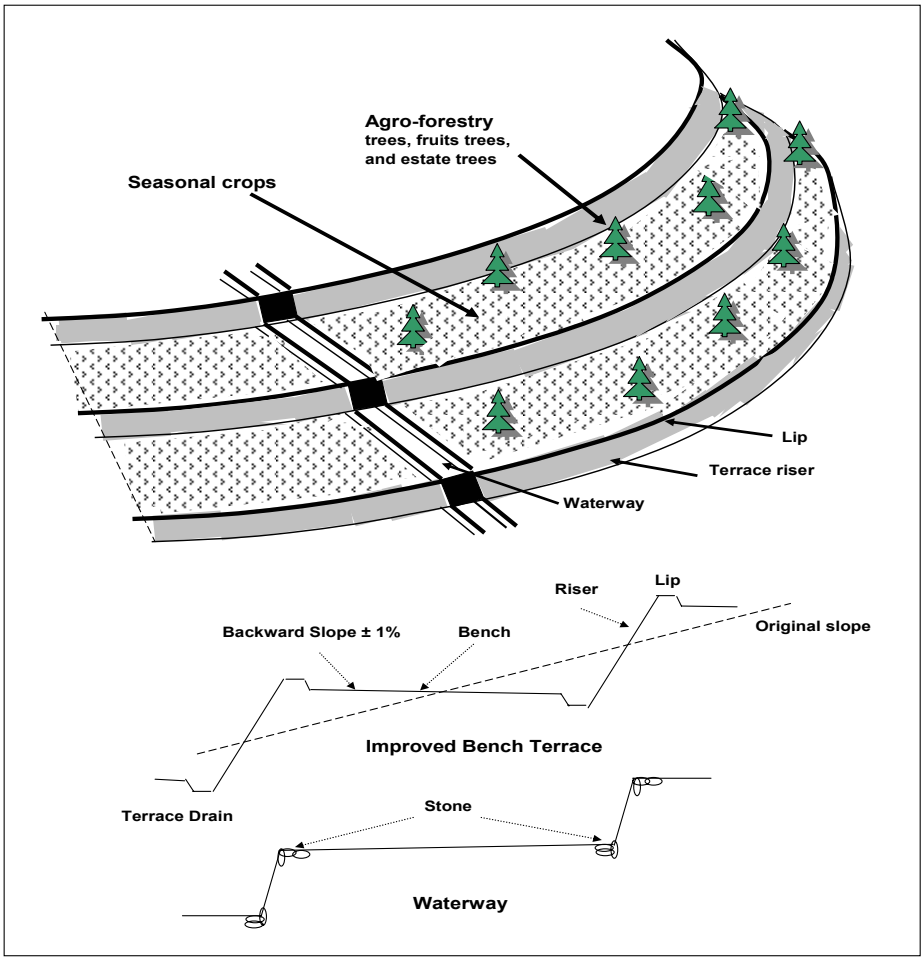
To ensure immediately effective and long term sustained soil and water conservation in the watershed area, the proposed types of terraces to different slope classes have been set as shown in the following table in the present study.

Table 2.2.17 Slope Classes and Land Use and Terrace Types

Slope Class	Current Terrace Type	
	Bench	Traditional Terrace/Composite 1/
	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 %		

1/: Associations of ridge and non-terrace;
Source: JICA Study Team

The standard design and image of the improved bench terrace are illustrated in the following figures and Figure 2.2.6.



Source: JICA Study Team

Figure 2.2.5 Image of Improved Bench Terrace

(3) Vegetative Measures

Variety of vegetative measures and various plants for the stabilization of bench terrace were or have been introduced in the past or current watershed conservation projects and activities in the watershed area. Aiming at accommodating such experiences into the formulation of the present study, vegetative measures in the past have been assessed. 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 performances8. The results of the assessment are presented in Table2.2.18. As indicated in the table, in case of grass, farmer's preference or fodder value of plant appears to be an essential factor for selection. Further, the assessment of adaptability of perennial crops (fruits and estate crops) in the project kecamatans by Wonogiri Agricultural Services Office is presented in Table 2.2.19. The basic vegetative measures and agro-forestry development directed to a bench terrace and vegetative measure to mitigate soil erosion in housing yard are presented in Table 2.2.20 and summarized as follows;

1: The measures and plants employed for individual target areas in the 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.

Table 2.2.21 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 Yard1/	Shrub	Flemingia congesta Roxb etc.

[1]/: Housing yard in home settlement;
Source: JICA Study Team

(4) Accommodation of Soft Components (support programs)

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

2.2.4 Classification of Subject Areas and Target Areas

(1) Classification of Subject Areas

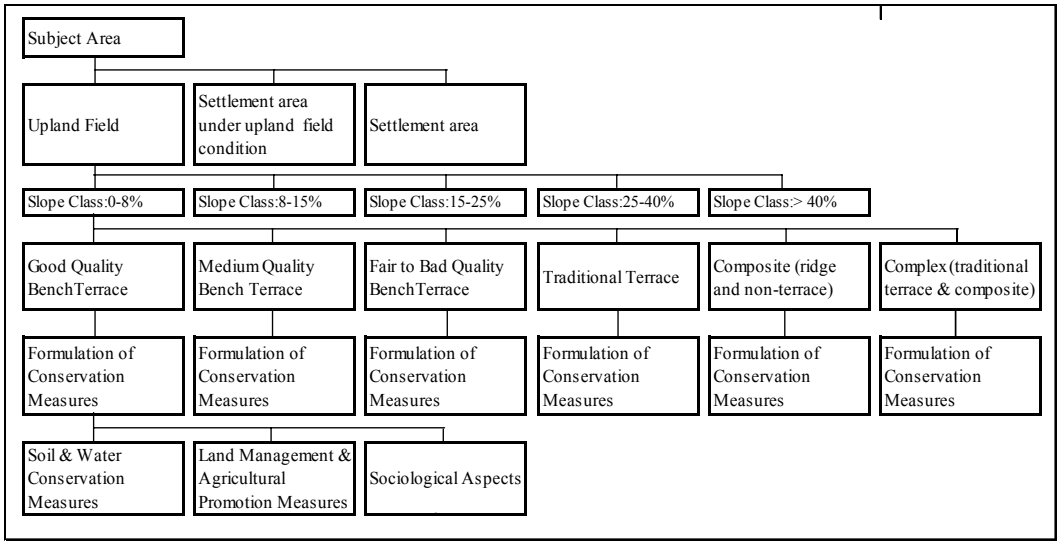
The factors of USLE that could be managed or mitigated through watershed conservation measures are P factor (land conservation factor) and C factor (vegetative/cultivation factor). Accordingly, for the formulation of watershed conservation measures, the subject areas have been classified into sub-units (land units) in order to facilitate the formulation of a conservation plan composed of soil and water conservation measures and agricultural measures. The land conservation factor which could be targeted by soil and water conservation measures is 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 2.2.22 Classification Criteria of Subject Area

Factor	Classification Criteria	Code
Land Use	Upland Field	U
	Pekarangan 1/	P
	Housing Yard 2/	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
	Complex (traditional terrace and composite	T6

1/: Settlement area under upland field condition 2/: 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 2.2.7 Classification of Subject Areas into Land units for Formulation of Conservation Measures

Based on the classification criteria for subject area, coding of land unit in subject area was shown in the following Table.

Table 2.2.23 Coding of Land Units in Subject Areas

Terrace Type and Condition	Slope Class (%)				
	0-8	8-15	15-25	25-40	>40
Upland Field					
- Good Quality BT 1/	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 2/	US1T5	US2T5	US3T5	US4T5	US5T5
Uplands in Settlement Area					
- Complex (composite and traditional terrace)	PS1T6	PS2T6	PS3T6	PS4T6	PS5T6
Housing Yard	HS1	HS2	HS3	HS4	HS5

1/: BT = bench terrace 2/: 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 as shown in the following table.

Table 2.2.24 Subject Area Classified by Coding of Land Units (ha) in the Wonogiri Watershed/3

	Slope Class (%)					Total	(%)
	0-8	8-15	5-25	25-40	>40		
Uplands							
-Good quality BT/1	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/2	1,351	1,629	2,482	3,366	5,249	14,080	21
Uplands in settlement area	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

BT1/: bench terrace
/2: association of ridge and non-terrace
/3: Subject area for the soil conservation plan does not include the area of State Forest area
Source: JICA Study Team

(2) Target Areas for Watershed Conservation Project

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

- The Wonogiri watershed conservation is carried out based on community's peoples (villages) as practitioners. The boundary map of villages in Wonogiri watershed was prepared based on the topographic maps on a scale of 1/25,000 made by BAKOSURTANAL. Village names and areas of village were identified.
- All the information and data necessary for estimate of soil loss were collected and input to the GIS for Wonogiri watershed management that was made in this Study.
- The annual average soil loss for each village within the Wonogiri watershed was calculated. Then the villages of which cover more than 100 ha and/or over 50 tons/ha/year, were screened selected for the Wonogiri watershed conservation.
- For each of the villages selected above, the annual average soil loss was calculated

for the three kinds of the land use area of i) upland field, ii) uplands in settlement areas and settlement areas. Then the villages with a total annual average soil loss per ha less than 50 ton/ha/year from three kinds of land use, were screened from the target subject areas.

- With respect to the proposed land use depending on slope classes (Refer to Table 2.2.16), rate of the introduction of the perennial fruits trees/trees (agro-forestry) was planned as 50% of the figure that the Indonesia Government proposes.
- Implementation of terrace improvement and terrace formation/upgrading works was planned as 80% for the total subject areas of the terrace rehabilitation works with 25-40% in steepness and 60% for the subject areas with over 40% from the viewpoint of access conditions to the sites, difficulties of terrace construction due to deep roots of big trees, very steep topographic conditions, uncertain farmers` intention of terrace making, etc. All the subject areas with less than 15% in steepness for terrace rehabilitation was planned to be carried out.
- Implementation for settlement areas (housing yards) by planting shrub at a fringe of village was planned as 60% of the total settlement areas.
- The State Forest area in the Wonogiri watershed is excluded from the target subject areas in this watershed conservation project.

The total number of selected villages in the Wonogiri watershed is 180 consisting of 83 in Keduang, 29 in Tirtomoyo, 8 Temon, 25 in Upper Solo, 19 Alang, 7 Ngunggahan, 7, Wuryantoro and 2 Remnant. The target subject areas for watershed conservation in sub-basins are about 34,400 ha as summarized in the following table. Details of the target areas in village levels are shown in Table 2.2.26.

Table 2.2.25 Target Area for Wonogiri Conservation for Sub-Basins

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
Uplands in settlement area			PS1T6	1,471	341	48	233	103	38	414	47	2,695	8
			PS2T6	1,820	417	199	496	404	136	200	53	3,725	11
			PS3T6	1,071	379	115	457	199	141	80	43	2,485	7
			PS4T6	400	288	44	273	84	59	28	20	1,196	3
			PS5T6	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

2.2.5 Proposed Watershed Conservation Projects

The proposed basic conservation measures consisting of soil and water conservation measures and agricultural promotion measures for the targeted subject areas of upland field, settlement areas under upland field condition and settlement areas have been formulated for individual land units being classified by slope classes and current terrace type and condition according to the basic directions as presented in Tables 2.2.27 and 2.2.28 and briefly discussed in the followings.

(1) Upland Field with Benched Terrace

Soil and water conservation measures envisaged in upland field 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 of vegetating of terrace lip and riser with grass or shrub for their stabilization.

Table 2.2.29 Proposed Terrace Improvement Works

Measures	Components
Physical Measures	Terrace lip improvement
	Terrace riser improvement
	Terrace bench improvement
	Improvement of waterway and drop structure
Vegetative Measures	Lip stabilization
	Riser stabilization

Source: JICA Study Team

The agricultural measures are formulated as land management and agricultural promotion concepts as shown in Table 2.2.28. As shown in the table, measures are studied on: 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 section 2.2.6 'Support Program for promoting watershed conservation projects'.

Table 2.2.30 Proposed Agricultural Promotion Measures

Subject	Measures
Land Management for Soil and Water Conservation	Farm land improvement
	Land use modification/conversion
Agro-forestry Promotion	Promotion of agro-forestry development
Crop Sub-sector Measures	Improvement of cropping system
	Technology development
	Palawija seed production
Livestock Sub-sector Measures	Livestock promotion

Source: JICA Study Team

The proposed measures are to be disseminated to farmers/farmer groups through the strengthening of participatory agricultural extension activities.

Proposed farming practices of annual crops consist of introduction of beans of higher productivity in a cropping pattern, drought tolerant crops in MT II, practices improving vegetative covers in MT II, preparation and use of quality compost as shown in Table 2.2.28.

Agro-forestry is considered as a soil and water conservation and agricultural promotion measure and it is envisaged that it will introduced over the entire farm land area for increase of farm income and for mitigating farm labor shortage problem slated in the near future in the watershed area as proposed in Table 7.2.27 and 2.2.28. The intensity of the introduction of agro-forestry is determined depending on slope class as set in the basic directions.

(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 uplands in settlement area are similar to those proposed for upland fields with bench terrace and defined as Terrace Formation/Upgrading Works and consist of physical measures and vegetative measures as shown in Table2.2.27 and as summarized below.

Table 2.2.31 Proposed Terrace Formation/Upgrading Works

Measures	Components
Physical Measures	Construction of improved terrace Construction of water way and drop structure
Vegetative Measures	Lip stabilization Riser stabilization

Source: JICA Study Team

Proposed agro-forestry development and land management and agricultural promotion measures in the subject areas are same as those proposed for upland field with bench terrace as shown in Tables 2.2.27 and 2.2.28.

(3) Settlement Area (Housing Yard)

Measure proposed to mitigate soil erosion in housing yards is to establish hedge rows at fringe of the yards and to construct side ditches along housing yard as shown in Table 2.2.27.

The preliminary design value of the proposed physical and vegetative means for watershed conservation projects per ha is summarized in the following tables.

Table 2.2.32 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. Agro-forestry					
- 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(ton/ha)	1	1	1	1	1
- NPK fertilizer and seed (package)	1	1	1	1	1

Source: JICA Study Team

2.2.6 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. For strengthening 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 are formulated

being directed to soil and water conservation and land management and agricultural promotion measures

(1) Support Programs for Soil and Water Conservation Projects

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 the direct and immediate benefits 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 staffs providing technical guidance and support to farmers and farmer groups is an essential initial and periodical step to be required for the efficient and successful implementation of the measures.

1) Farmers and Farmer Groups Empowerment Package Program

The package program aims at formation and empowerment of farmer groups by supporting formation of beneficiary farmer groups and providing technical guidance to farmers and farmer groups as a preparatory stage for the implementation of the conservation measures. Accordingly, the program is composed of: i) farmer group formation program and ii) farmer group empowerment program. In addition, need assessment of target farmers should be made for the formulation of definite plan for conservation measures as follows;

Farmer Group Formation Program

- Farmer group formation (mass guidance/socialization/workshop and support for formation)

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 and trees to be introduced in the proposed measures

The program description is shown in Table 2.2.33.

2) Package Program for Operation/Implementation of Conservation Measures

The package program aims at providing technical and financial support for beneficiary farmers or practitioners and consists of: i) Terrace Formation Guidance Program, ii) Agro-forestry Development Program and iii) Field Guidance Program as follows;

Terrace Formation Guidance Program

- Technical guidance on proposed soil and water conservation measures
- Provision of grasses/trees for terrace stabilization
- Labor cost subsidy for physical measures (terrace improvement/ formation/upgrading works)

Agro-forestry Development Program

- Technical guidance on agro-forestry development
- Provision of support package (seedlings and farm inputs) for agro-forestry development envisaged in the proposed measures

Farming Support Program

- Technical guidance on farming system improvement
- Provision of soil ameliorant and farm inputs

Field Guidance Program

- Inception technical guidance and support to beneficiary farmers and farmer groups
- Follow-up technical guidance and support

The program description is shown in Table 2.2.33

3) Field Staff Empowerment Program

The program is to provide induction and periodical refresher training or technical guidance for field staffs involved in the implementation of the proposed measures as explained in Table 2.2.33.

(2) Support Programs for Land Management and Agricultural Promotion

The support programs are formulated aiming at strengthening of 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 and 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 as shown in Table2.2.33.

(3) Support Programs for Community Development

The support programs are formulated aiming at empowerment of village people and organizations. The support programs provide various supports 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 the village grant fund, and v) education program on watershed conservation and as shown in Table 2.2.34. The outlines of village grant fund and education program on watershed conservation are shown in Table 2.2.35 and Table 2.2.36, respectively.

(4) Monitoring and Evaluation at Village Level

The monitoring and evaluation (M and E) at village level are formulated aiming at empowerment of village people and organization for feedback and project modification. The M and E works as empowerment approach should include: i) supervision of the works by the village, ii) project impact analysis by the village, iii) necessity modification of project based on the project evaluation, and iv) knowledge building based on lesson and learn from the project. The (M and E) at village level is shown in Table 2.2.37 and summarized below:

Table 2.2.38 Summary of M and 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

2.2.7 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) sideditch construction works, and vii) other support programs for land management and agricultural promotion. After implementation of the project, all the present upland fields consisting of uplands with bench terrace, traditional terrace area, uplands with composite and uplands in settlement areas will become uplands with improved bench terrace. Agro-forestry development will be made in some of the improved terrace lands. Except for the settlement areas, soil amelioration will be carried out under the farming support program. Hedgerow works and construction of side ditch will be made for some settlement areas.

Reduction of soil loss in the Wonogiri watershed is expected after implementation of the watershed conservation projects. The water conservation projects will be carried out about 34,400 ha of the target subject area as mentioned in section 2.2.4(2). The soil loss in the Wonogiri watershed after implementation of the watershed conservation projects is estimated by USLE.

The parameters used calculation for soil loss production after implementation of the project are shown below.

Table 2.2.39 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

Based on the above parameters, the annual average soil loss in the whole Wonogiri watershed and in sub-basin is estimated and shown in the following tables. After the implementation of the projects, it is estimated that the soil loss will be reduced about 8.08 million tons per year from the Wonogiri watershed as following tables:

Table 2.2.40 Reduction of Annual Average Soil Loss in Wonogori Watershed

Land Categories	Annual Average Soil Loss (1,000 ton/year)		Reduction of Annual Average Soil Loss (1,000 tons/year)
	Present condition	After implementation	
(1) Paddy field	18	18	0
(2) Settlement area			
(i) Home settlement area	1,761	1,564	197
(ii) Settlement area under upland field condition	3,792	2,373	1,419
(3) Upland field	9,120	3,856	5,264
(4) Orchard and Plantation	1,071	1071	0
(5) Forest	14	14	0
(6) State forest land*			
(i) forest land	16	16	0
(ii) other land use	1,454	256*	1,198
(7) Other land use	34	34	0
Total	17,279	9,202	8,077

Remarks: *: This annual average soil loss is estimated that 90% of the other land use in the state forest land will be reforested.

Source: JICA Study Team

Table 2.2.41 Reduction of Annual Average Soil Loss in Sub-Basin

Sub-basin	Annual Average Soil Loss (1,000 tons/year)		Reduction of Annual Average Soil Loss (1,000 tons/year)
	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) Ugunggahan	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 that 90% of the other land use in the state forest land will be reforested.

Source : JICA Study Team

Details on annual average soil loss production and annual average soil loss /ha for the entire Wonogiri watershed after implementation of project are shown in Tables 2.2.42 and 2.2.43 and for sub-basin in Tables 2.2.44 and 2.2.45.

Details on annual average soil loss production and annual soil loss /ha on village level at present condition and after implementation of project are illustrated are at Figures2.2.8, 2.2.9, 2.2.10 and 2.2.11.

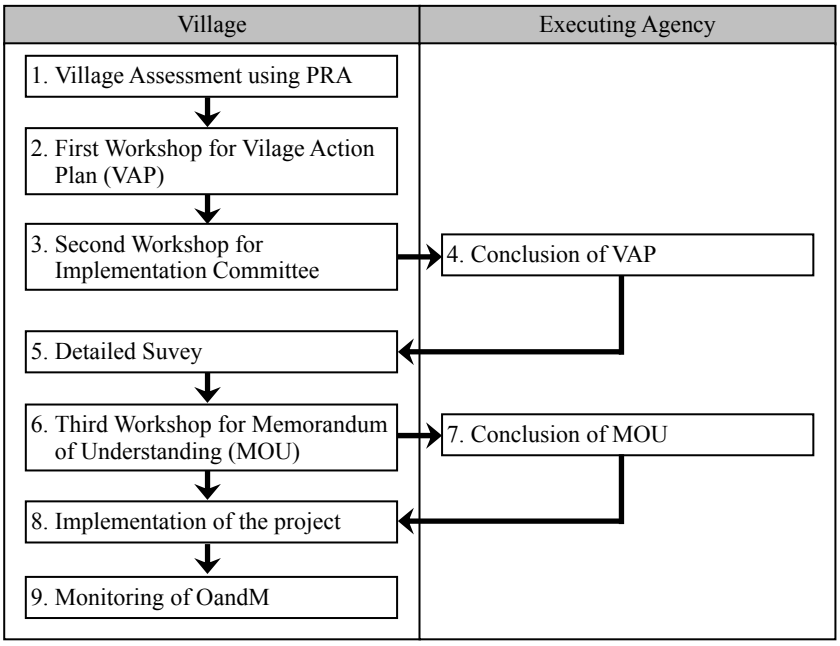
It may be concluded from the above table that 47% (8,077/17,279) of the total annual average soil loss at present is trapped or reduced after implementation of the project.

2.3 Implementation Plan and Proposed Implementation Arrangement for Watershed Conservation Projects

2.3.1 Implementation Plan

(1) Procedure

Local people will be the most important factor in good watershed conservation and management. Considering participatory manner to be made by the community and local people, it will be important that, i) people's understandings for the soil conservation through PRA and other surveys, ii) people's initiative through preparation of village action plan (VAP) and formulation of implementation committee, iii) responsibility share between exacting agency and village through formulation of Memorandum of understanding MOU. Therefore, the following nine steps as procedure are proposed in the following figures.



Source: JICA Study Team

Figure 2.3.1 Implementation Procedure

The detailed explanation of each step is as follows;

1) Village assessment

The village assessment using participatory rural appraisal (PRA) should be made in order to utilize local knowledge and increase people's understandings on soil erosion. The PRA includes: i) informal interviews, ii) focus group discussion, 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

In succession to the village assessment, the village workshop should be held for formulation of an action plan for soil conservation and consensus building for priority of needs and location amongst village people. The workshop includes, i) result 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

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

The representatives of stakeholder groups related to the proposed works should be included as members of committee. The members will involve the representatives of village, farmers group, women group, soil conservation group etc. At least, the members should involve the representatives of hamlet, since the activities will be made at hamlet basis.

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

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

5) Implementation of detailed survey

The meeting will be held for explanation of discussion results with executing agency as well as content and schedule of detailed survey. Under the initiative of the implementation committee, 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

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

7) MOU conclusion

Based on the result of the detailed survey, a memorandum of understanding (MOU) on the project should be concluded between executing agency and the implementation committee. The MOU should include: i) components and its work volume covered by the project, ii) share of the responsibility in the implementation stage, and iii) share of responsibility in the operation and maintenance stage,

8) Implementation of project

Before the commencement of the project, the content of the MOU and the procedure of the project will be explained to the whole village. The project included 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 one should be made under the monitoring of the implementation committee. The issues and their countermeasures should be discussed from time to time. The progress report will be prepared at quarter basis and submit to both Kecamatan (sub-district) office and executing agency.

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

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

(2) Priority and Implementation Schedule of Subject Area

For the implementation of the project, priority of subject area is set-up for the step-by step implementation, since the project can not cover those huge area (34,400 ha) at once for the implementation. The basic approach for the prioritization is as follows:

- All the works should be made at village basis, since the implementation committee will handle the works with technical assistance of the executing agency.
- To avoid the conflict amongst villages, the project should implement in all the villages located in the same sub-watershed as much as possible. Local NGO also noted that equal implementation amongst sub-watersheds is not recommended.
- Higher priority should be put to the sub-watershed located near dam site such as Keduang sub-watershed, since protection of intake against sedimentation is most important and urgent.
- Higher priority should also be put to the sub-watershed that has higher total annual average soil loss.
- Development area per annum should be considered taking into consideration of labor availability in the Wonogiri watershed.

Based on the above approach, the prioritization and implementation schedule is set-up as shown in the following figure.

Sub-watershed	Rank of total annual soil loss	No. of villages	Subject area (ha)	nentation 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								
		180	34,400								

: Socialization and planning
: Implementation
: Monitoring

Source: JICA Study Team

Figure 2.3.2 Implementation Schedule for Watershed Management

2.3.2 Proposed Implementation Arrangements at Field and Village Level

(1) Organizational structure

In the watershed area, farmers holding size is limited and measures will become a dispersed manner with limited effects when measures are introduced individually by interested farmers. Therefore, community based introduction of measures is to be envisaged, which dictate understanding and agreement on proposed measures by a number of 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 a responsible role for the proposed watershed conservation as practitioners from the stage of planning and collaborative activities of all stakeholders, communities and implementing agencies, for the implementation of the conservation are essential.

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 member 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 practitioners groups, Kelompok Konservasi Tanah dan Air (K2TA; Soil and Water Conservation Farmer Group) will also be formulated. Such formation and induction empowerment guidance is to be executed in a year prior to the implementation of conservation measures after the socialization of the measures or project activities. Following the formation of K2TA, 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 measure and farming support program and Agro-forestry Development are to be implemented from the 2nd year as shown in Figure 2.3.3.

The proposed organization set-up at field and village level for the implementation is K2TA at farmer/farmer group level and Village K2TAs at village level as shown in Figure 2.3.4. K2TA is to be formed as a practitioner at farmer/farmer group level and Village K2TA is to be established as a practitioner at a village level.

(2) Role and Responsibility amongst Stakeholders at Village Level

To avoid confusion amongst stakeholders, the role and responsibility should be defined. The role and responsibility should be finalized in the workshops with consent amongst people. However, the tentative role of each component will be presented as follows

Table 2.3.1 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 and Evaluation	K2TA	Implementation Committee	NGO and Executing Agency
(5) Support Programs for Soil and Water Conservation Measures	Extension staffs (PPL/PKL) and Consultant	Implementation Committee	Executing Agency
(6) Support Programs for Land Management and 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 2.3.2 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

CHAPTER 3 PRESENT CONDITIONS OF THE PROJECT AREA FOR FEASIBILITY STUDY

3.1 General

The Keduang watershed (about 42,000 ha) was identified as the highest priority for implementation of the watershed conservation in the Mater Plan Study (M/P) that was mentioned in Section 2.3.1 Chapter 2. The feasibility study (F/S) has been started from July, 2006 to March 2007. In the F/S, the land use map prepared under the M/P has been updated. Also necessary data has been improved and updated. Based on the results of those analyses, constraints and problems encountered for watershed management in Keduang watershed were identified and also soil loss analysis on village level were estimated. As a result, 82 villages as target areas of the planned watershed conservation activities were selected from 98 villages in the Keduang watershed. These target villages are under jurisdiction of 9 kecamatans in Kabupaten Wonogiri. The area extent of the selected villages is about 36,900 ha in total (herein called the project proposed area) and accounts for 88% of the Project Area (the Keduang watershed). The methodology on selection of villages is mentioned in Chapter 4.

3.2 Socio Economic Condition

3.2.1 Administrative area

The Project proposed area is totally located all within Wonogiri District, Central Java Province. It has 9 kecamatans, 82 villages and 517 Dusuns (hamlets) as shown below: An administrative boundary map in the Keduang watershed is shown in Figure 3.2.1.

Table 3.2.1 Administration Divisions of Project Proposed Area in the Keduang Watershed

Province	**Kabupaten**	Name of Kecamatan	No. of Desa*	No of Dusun**
Central Java	Wonogiri	Girimarto	12	93
		Jatipurno	11	66
		Jatiroto	10	46
		Jatisrono	15	69
		Ngadirojo	6	63
		Nguntoronadi	1	9
		Sidoharjo	12	103
		Slogohimo	14	58
		Wonogiri	1	10
Total			82	517

Source: *Result of GIS analysis made by JICA Study Team, Nov. 2006
**Statistical year book of Kecamatan ,2004

3.2.2 Population

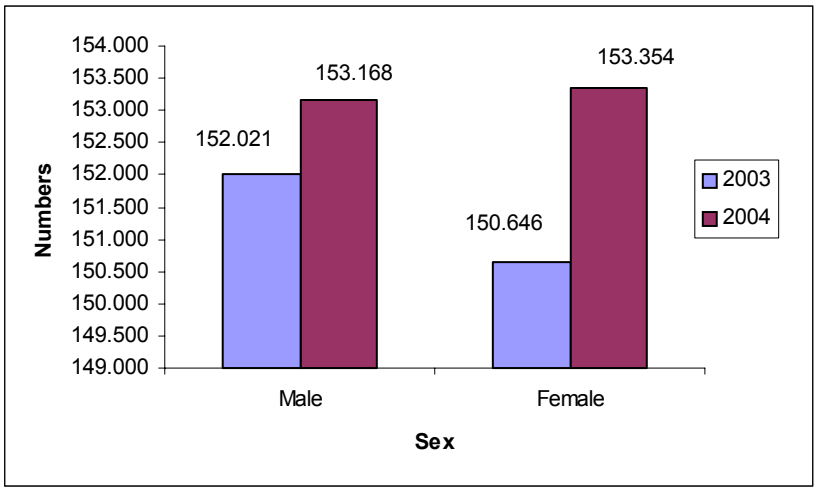
(1) Number, Growth Rate of Population, and Density

The total population was 306,522 in 2004. The annual population growth rate was 1.26% from 2003 to 2004. The population density was as high as 817/km^2 in 2004. Comparing with Indonesian and Central Java population condition, the rate of population growth and density during 2003-2004 is higher than both.

(2) Sex Profile, Household and Family Size

Sex profile in 2003 comparing with 2004, the figures highly difference, such as in 2003,

male numbers is higher than female, with sex ratio[9] about 100.91. It means in every 100 female, there are 100.91 male Contrary, female numbers is higher at 2004, with sex ratio about 99.88. It means in every 100 female, there are 99.88 male. The difference of sex ratio in 2003 and 2004 is related with natural population growth (fertility/birth and mortality/dead) and migration (in and out migration). During 2004, male fertility (birth) is higher than female, and in contrary female mortality (dead) is higher than male. Similarly with those, there are big different rate of out and in migration between male and female. Consequently, increasing rate for male and female is quite different. Female increasing is higher than male rate. Male increasing rate from 2003 to 2004 is about 0.75%, and female is about 1.8%. Numbers of each sex and compositions is shown below:



Source: Statistical year book of Kecamatan ,2004

Figure 3.2.2 Sex Profile in Project Proposed Area

The total household in the Project area is about 65,007 and an average family size is 4.72. Household condition refers to quantity of household, density of household per km^2 and family size in such an area. In 2004, household population in project proposed area is 26.60 % from household in kabupaten Wonogiri or 33.84 % of it in Wonogiri catchment's area. But household density in project proposed area is bigger than either in kabupaten or Wonogiri catchment's area. Family size in project area is bigger than in Kabupaten Wonogiri or chacthment area of Wonogiri reservoir, as shown below:

Table 3.2.2 Household, Household density and Family Size In Project Proposed Area, 2004

Kabupaten	Household (HH)		Family Size	
	2004	2005	2004	2005
Kabupaten Wonogiri	244,386	255,955	4.57	4.38
Wonogiri watershed	192,051	201,143	4.57	4.38
Project proposed area	65,007		4.72	

Statistical year book of Kabupaten Wonogiri 2004 and Kecamatan in 2003 and 2004

(3) Natural Population Growth, Mortality, and Fertility

The height of increasing rate of population and density is related with natural population growth and migration. Hypothetically, it could be said that increase rate of population and density are contributed by natural population growth, decrease of out migration and

[9] Sex ratio is the ratio of males to females in a given population and year, usually expressed as the number of males for every 100 females. (BPS, Statistical Yearbook of Indonesia, 2004, June 2005:p. 59.)

increase of in migration. These figures are shown below:

Table 3.2.3 Natural Population Growth, Mortality and Fertility in Project Proposed Area

	Natural Population Growth (%)		Fertility		Mortality	
	2003	2004	2003	2004	2003	2004
Kabupaten Wonogiri	0.62	0.44	11961	9113	5006	4163
Project proposed area	0.62	0.64	3474	3401	1589	1525

Source: Statistical year book of Kabupaten Wonogiri 2003 and Kecamatan in 2003 and 2004

(4) Migration

Out migration in the project proposed area is decreasing to 45% from 2,312 persons in 2003 to 1,268 in 2004. But , for in migration, it increases about 45% from 620 persons from 2003 to 2004. These migration conditions are largely affected by that of Kecamatan Slogohimo. Out migration in Slogohimo dcreases 52% (from 1,697 in 2003 to 821 in 2004) and in migration increases 49% (from 832 in 2003 to 1,641 in 2004). Those are highly different with increasing rate in Kabupaten Wonogiri and Wonogiri Watered that is decreasing on both migrations. Wonogiri people conducted migration for working in other city, such as Jakarta, Surabaya, Surakarta etc. These could be described below:

Table 3.2.4 Population, out and in Migration in Project Proposed Area

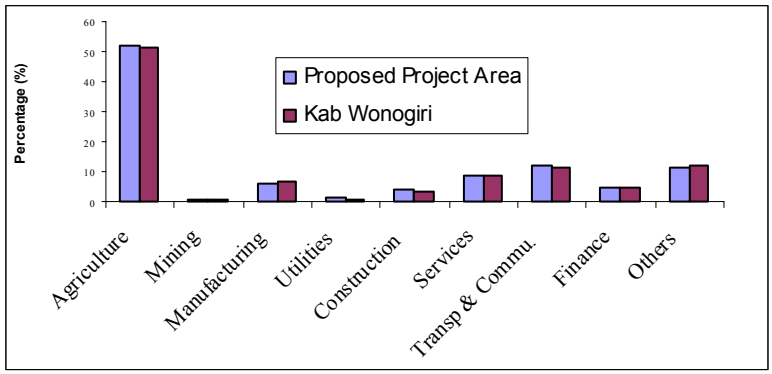
	Out migration		Increasing Rate (2003-2004) %	In migration		Increasing Rate (2003-2004) %
	2003	2004		2003	2004	
Kabupaten Wonogiri	6, 513	4,354	-0.33	5,229	4,045	-0.23
Wonogiri Watershed	6,908	4,428	-0.36	5,406	4,058	-0.25
Project proposed area	2,312	1,268	-45.16	1,375	1,995	0.45

Source: Statistical year book of Kecamatan in 2003 and 2004

3.2.3 Economic Profile

(1) Economic Structure

The agricultural sector in Kabupaten Wonogiri was the most dominant sector in terms of contribution to 51% of RGDP of Kabupaten Wonogiri. Major agricultural commodities are 1) seasonal crops such as paddy, polowijoo, chili, etc, 2) perennial crops such as cashew nuts, coconuts, cloves, bananas, chilies, 3) timber's production such as teakwood and Mahagoni and Senokeling and 4) livestock production, followed by transportation and communication, services, manufacturing, etc. The agricultural sector in the Project area also is estimated to contribute to 52 % of RGDP in 2004 and about 45% of Kabupaten Wonogiri. RGDP shared by sectors is shown in the figure and tables.



Source: PDRB Kecamatan in 2004; kerjasama BPS and Bappeda Kab. Wonogiri

Figure 3.2.3 RGDP shared by Sector based on Kabupaten Wonogiri and the Project Proposed Area (%)

The average of DGDP per capita in project area is estimated to be 2.36 million Rp/year/person, or Rp 6,500 (or 0.7$) /day/person, which is a little below than the average in Kabupaten Wonogiri (2.6 million Rp). For DGDP in project area is 44.59% of DGDP of Kabupaten Wonogiri. It seems, the project area is become the most supported DGDP to Kabupaten DGDP.

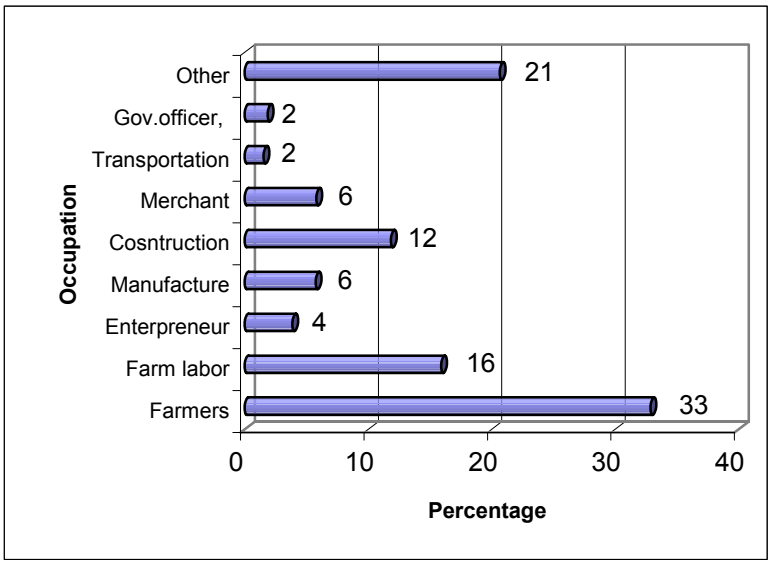
Table 3.2.5 PerCapita DGDP in Kabupaten Wonogiri and Project Area in 2004

	DGDP/capita/year	DGDP/year
	Rp.million current	Rp.million current
Indonesia	2.13	45,8401,654
Central Java Province	1.42	45,605,369
Kab. Wonogiri	2.6	2,984,864
Kecamatan in Project Area		
Girimarto	1.9	92,520
Jatipurno	1.7	68,768
Jatiroto	2	87,989
Jatisrono	2.3	156,504
Ngadirojo	4.1	245,743
Nguntoronadi	2.8	79,761
Sidoharjo	2.2	105,718
Slogohimo	1.9	103,339
Wonogiri	4,5	390,727
Total in Project Area	23.4	1,331,069

Source: PDRB Kecamatan in 2004; kerjasama BPS and Bappeda Kab. Wonogiri

(2) Labor force / Man Power

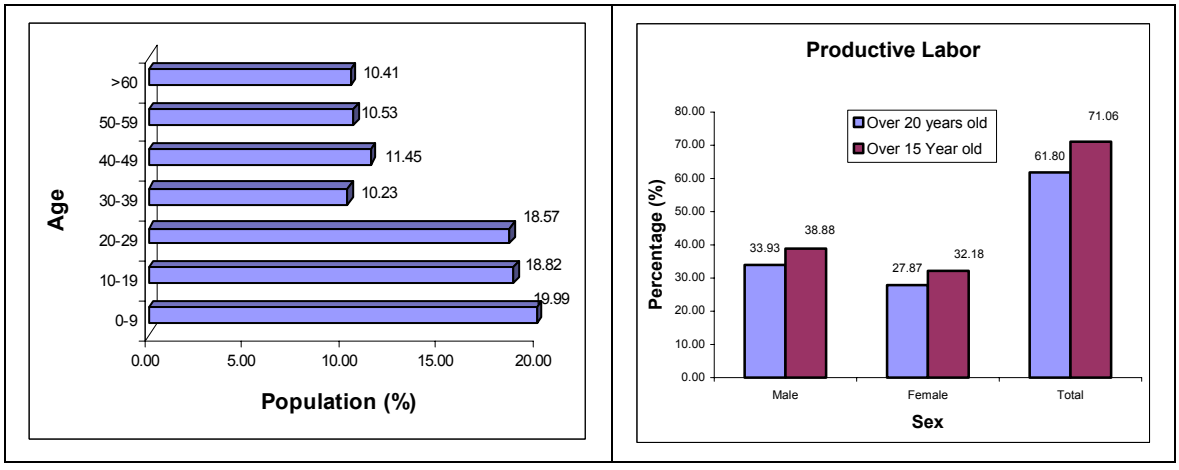
Based on the village profile, the agricultural sector absorbed about 49% of the total employment in the project area in 2004 as shown below.



Source: Statistical year book of Kecamatan in 2004, Village Profile 2005

Figure 3.2.4 Employment in Project Proposed Area, 2004

The productive labor forces which is supposed to be composed of over 20 years old, is about 182,613 person or about 61.8% of the total population in project area. On the basis of the Indonesian standard that productive labor force is persons over 15 years old, it is estimated at about 209,593 persons or 71.06% of total population. Dependency ratio[10] of population in Project area is 63. It means that in every 100 population at age 15 up to 60 have to support 63 persons. The detail information is shown below:



Source: Statistical year book in 2004, Village Profile 2005

Figure 3.2.5 Population Classified by Age and Productive Labor Force in Project Area

3.2.4 Social Profile

(1) Religion

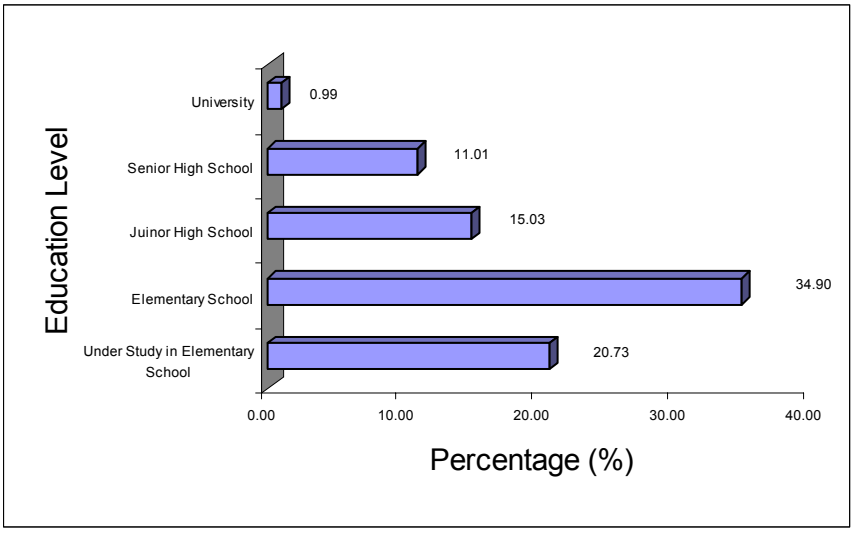
About 98% of the population in the project area is Moslem, followed by Christians Catholics/Protestant (1.4%); Buddhism (0.4%); and Hindu (0.0%). All of the populations

[10] Dependency ratio means value of load support of every 100 productive (15-60 years old) to unproductive age (below 15 years old and over 60 years old).

are Javanese.

(2) Education Profile

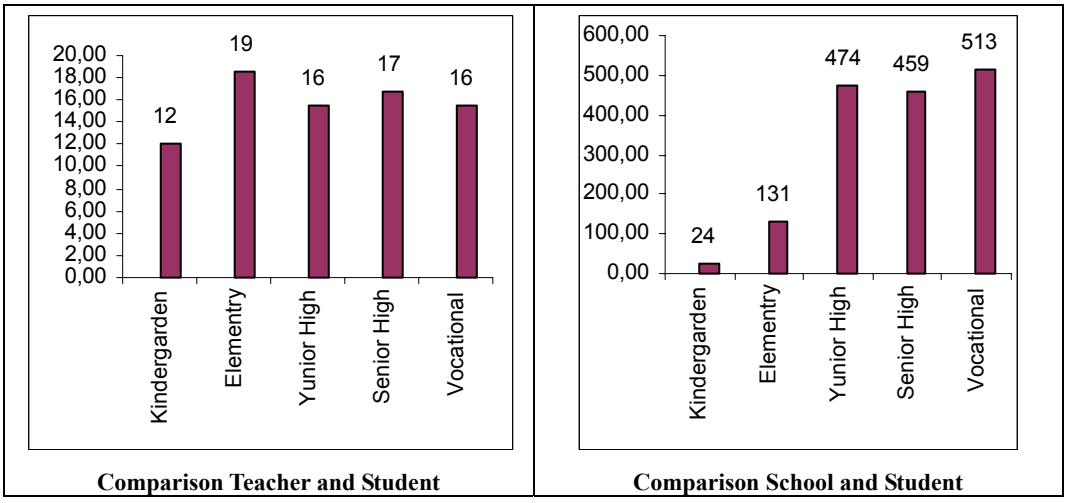
55% of the population in the project area has received an elementary education. It is dominated by elementary school (35%) and under elementary (21%). 15% of the populations has graduated from Junior High School and the remaining 11% from tertiary education (Senior High School and University), as shown below:



Source: Statistical year book of Kecamatan in 2004

Figure 3.2.6 Education Achievement

Profile of education in the Project proposed area shows that the numbers of teacher in every level of education are not so different. The ratio of the numbers of students/a teacher ranges from 12 at kindergarten to 19 at elementary school. It seems that the number of students per a facility for junior high schools, senior high schools and vocational schools is insufficient. The summary is shown below:

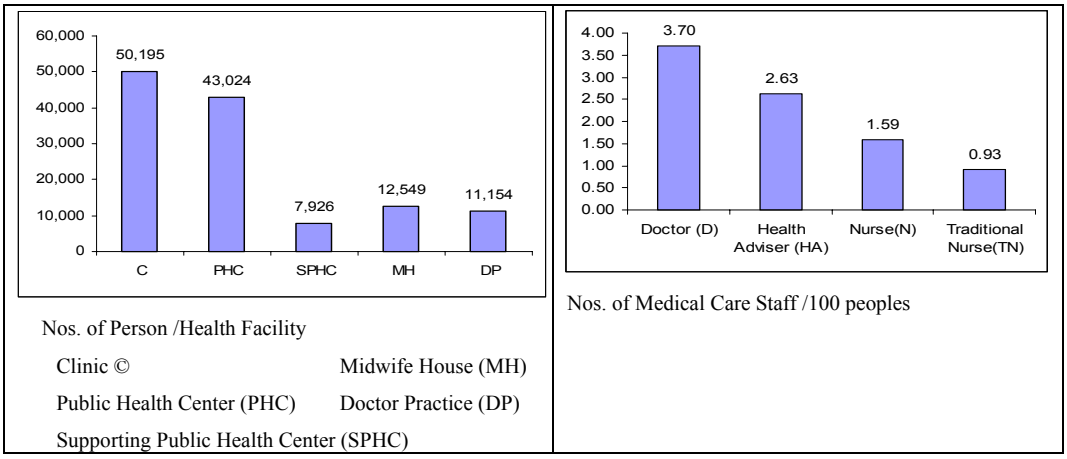


Source: Statistical year book of Kecamatan in 2004, Villages potency 2005.

Figure 3.2.7 Education Profile

(3) Health Profile

Health facilities are insufficient in the project area. Every clinic has to provide services to 50,200 peoples, public health centre to 43,000 peoples and supporting public health center (SPHC) to 7,926 peoples. The numbers of medical care staff are also insufficient in the project areas, as indicated by the ratios of the number of staff/100 local peoples: 3.7 doctor, 2.63 health advisor, 1.59 nurse and 0.93 traditional nurse. The total number of public health service post (POSYANDU) is about 440 in the project area, playing an important role in provision of various health advice/services such as maintaining health of mother and child (during pregnancy until under 5 years old). The summary is shown below;



Source: Statistical year book of Kecamatan in 2004

Figure 3.2.8 Health Facilities and Medical Care Staff

(4) Poverty

The government determined poverty line for each year in Indonesia on the basis of the standard of poverty line of capita/month/family in 1998. The following table shows that poverty line from 2002 to 2004 in Indonesia and its trend. It is increase .6.36% per year to year in 2002-2003 and 3.35% in 2003-2004 for urban as well as 9.71% per year in 2002/2003 and 2.68% in 2003/2004 at rural community, as shown in table below:

Table 3.2.6 Standard of Poverty Line in Indonesia

	Poverty line (Rp./family)		Poverty line (Rp/family)	
	Urban area		Rural area	
	Monthly	Yearly	Monthly	Yearly
2002	130,499	1,565,988	96,512	1,158,144
2003	138,803	1,665,636	105,888	1,270,656
2004	143,455	1,721,460	108,725	1,304,700
	Increasing rate		Increasing rate	
2002/2003	6.36	6.36	9.71	9.71
2003/2004	3.35	3.35	2.68	2.68

Source: Statistical year book in Indonesia in 2005

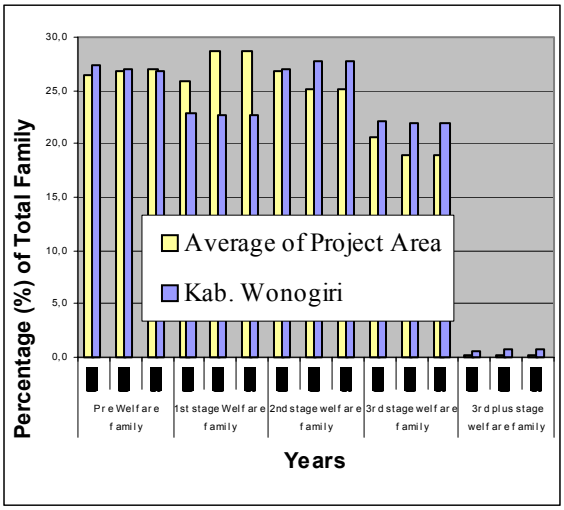
There is no data available about income or expenditure in the Project area. Accordingly, the local government (Kabupaten Wonogiri) uses the classification of the stage of family welfare to specify poverty instead. The classification divides into 5 as shown below:

Table 3.2.7 Classification of Poverty in Kabupaten Wonogiri

Classification	Definition
1. Pre-stage of family welfare	Families which can not fulfill the basic needs.
2. 1st stage of family welfare	Families which can fulfill the basic need, but can not fulfill socio psychological needs.
3. 2nd stage of family welfare	Families which can fulfill basic needs, and socio psychological needs, but can not fulfill entire development needs.
4. 3rd stage of family welfare	Families which can fulfill basic needs, socio psychological needs, and development needs, but can not contribute to society, such as material and financial for social interest.
5. 3rd plus stage of welfare family	Families which can fulfill all needs and sustainable contribution to society.

Source: Petunjuk teknis pendataan keluarga 2006, Vadan kooedinasi Keluarga Berencana National, Propinsi Jawa Tengah , 2005

It is defined that classification of 1st stage of family welfare is poverty line. The peoples within pre-stage and 1st stage of family welfare are classified into the poverty class. As shown in the following figure, over 50% of peoples in both Kabupaten Wonogiri and the project area is assessed as being in a the poverty class and the poverty is apt to trend to worsen from 2003 to 2005.



Welfare Condition

Pre Welfare family	2003/2004	1.49
	2004/2005	0.66
Average	2003/2005	1.08
1st stage Welfare family	2003/2004	10.09
	2004/2005	-0.03
Average	2003/2005	5.03
2nd stage welfare family	2003/2004	-6.61
	2004/2005	-0.60
Average	2003/2005	-3.61
3rd stage welfare family	2003/2004	-9.03
	2004/2005	0.11
Average	2003/2005	-4.46
3rd plus stage welfare family	2003/2004	29.86
	2004/2005	-1.38
Average	2003/2005	14.24

Welfare Rate

Source: Statistical year book of Kecamatan in 2004 and 2005

Figure 3.2.9 Increase Rate of Family Welfare Condition, 2003 - 2005

(5) Accessibility and other Facilities

People in the project area are not isolated. The rural road system is well developed. Public transportation is available in the area. Even, transportation necessary for agricultural produces is available making it easy to reach market in the Kabupaten capital or other cities. The traditional markets in the Project area are in only **6** kecamatans of among 9 kecamatans in the Project area. The animal market is available in each kecamatan except that no data available in Slogohimo. People in the Project area utilize water from spring, shallow and pump well, hydrant, PDAM, river, pipe system and pond for drinking water. Most of people (40.7%) in the Project area utilize pipe system. But, the numbers of water source, shallow well (70.2%) are the most.

Table 3.2.8 Facilities in Project Area

Markets and Number of Transportation Equipment

Facilities	Nos
Public Market	6
Village Market	23
Animal Market	7
Store	745
Mini Bus/Bus	67
Sedan	332
Truck	121
Pic-up	396
Motor Cycle	6626

Drinking Water Supply in The Feasibility Area for Watershed Management

Type	Unit (%)	User (%)
Spring	14.2	28.5
Shallow well	70.2	16.5
Pump well	14.9	4.7
Public hydrant	0.1	1.5
PDAM	0.0	5.4
River	0.6	2.9
Pipe System	0.0	39.7
Pond	0.1	0.8
Total	100	100

Source: Village profiles in 2005

3.3 Soils and Topography

The soils distributed in the project area are classified following the old Indonesian classification system, into three soil types of *Mediteran* (Soil Taxonomy: Typic Eutropept/Oxic Dystropept), *Latosol* (Typic Dystropept/Typic Humitropept/Oxic Dystropept) and *Litosol* (Inceptisols). The distribution of the soils in the Wonogiri watershed is shown in Figure 1.1.1 in Section 1.1.1 Chapter 1 and presented below in comparison with the same in the Wonogiri catchment area.

Table 3.3.1 Soil Distribution in Project Area and Wonogiri Catchment

Soil Type	Distribution		
	Keduang		Wonogiri
	(ha)	(%)	(%)
Mediteran	18,489	44	42
Latosol	14,132	34	25
Litosol	9,475	23	12
Grumusol	0	0	21
Project Area Total	42,098	100	100

Source: JICA Study Team

Major characteristics of the soils distributed in the area are explained in section 1.1.3.

Topographically, the project area is steep. 53% of the project area is classified into steepness with over 8% in gradient. The lands are deeply dissected by many tributaries, resulting in slope lands that become very steep.

3.4 Agriculture and Forestry

3.4.1 Land Use

In the present F/S study, the land use map prepared under the master plan study has been updated through a detailed ground truth survey, focused on reviewing land uses classified as paddy field, upland fields and settlement areas. The updated present land use map of the Project Area is shown in Figure 3.4.1.

The land uses in the Area have been classified into land use categories of: i) paddy field, ii) upland field (*tegalan/ladang*), iii) upland field in home settlement (*pekarangan*), iv) housing yard in home settlement, v) forest, orchard and plantation (*hutan and kebun/perkebunan*), vi) State Forest and vii) others. Among the categories, paddy field occupies the largest share followed by home settlement and upland field. The upland

fields are areas extensively used for dry land farming. The share of forested area (forest, orchard and plantation) other than State Forest is rather limited in the Area. The land use features in the Area are shown in comparison with the same in the Wonogiri watershed as follows;

Table 3.4.1 Present Land Use in the Project Area and Wonogiri Watershed

Land Use Category	Project Area		Wonogiri
	Area (ha)	Proportion (%)	Proportion (%)
(1) Paddy Field	13,042	31	25
(2) Upland Field	8,491	20	32
(3) Home Settlement	11,064	26	22
- Upland field in home settlement	7,250	17	(15)
- Housing yard	3,814	9	(6)
(4) Orchard/Plantation	3,920	9	10
- Orchard/plantation	3,707	9	10
- Dense forest	213	-	-
(5) State Forest 1/	5,027	12	10
- Dense forest	201	-	-
Re-forested land Other use	4,826	12	10
Others	337	1	1
Total	41,883*	100	100

1/: Include lands under forest and upland field conditions, *: Difference of areas between M/P and F/S may occur by calculation of GIS
Source: JICA Study Team

The characteristics of major land use categorized are as follows;

(1) Paddy Field

This land use category consists of irrigated paddy field and rainfed paddy field. Lands are mainly distributed in moderately to steeply sloping areas of the Keduang. Irrigated paddy fields are served from the tributaries of the Keduang and springs and commonly used for double cropping of paddy, while in rainfed paddy fields single cropping paddy.

(2) Upland Field

The upland fields in the Keduang are mostly bench-terraced with different protection measures and maintenances and intensively used for seasonal crops. To a limited extent of uplands, there are ridged-terraced or used without terrace construction. Major crops are maize, cassava and beans, and cropping index is dependent on seasonal rainfall distribution. Upland fields are the most serious soil erosion sources in the Project area..

(3) Home Settlement

Lands under this category include housing yards, home gardens and surrounding areas under upland field conditions. The home gardens are used intensively for agricultural purposes and provide an important source of farm income and are commonly planted with a variety of crops including vegetables, palawija, fruit trees as mango, banana, rambutan and papaya and even estate crops such as coconut, clove, cashew nut, cacao and *melinjo*. Upland fields accommodated in this land category are used for seasonal crops production with limited soil conservation measures. Upland fields in home settlements are one of the main sources of soil erosion in the area and proper soil conservation measures are essential for the mitigation of the sedimentation problems in the Wonogiri Reservoir.

(4) Forest/Orchard/Plantation

This category of land in the Area practically consists of peoples forests (*hutan rakyat*) and

tree crops planted areas (or orchard, *kebun*) since the areas covered with pure stands of estate crops (*perkebunan*) are limited in the area.

A dominant tree planted in the people's forests is teakwood (*Tectona grandis*) and other tree species include *sonokeling* (*Darbegia grandis*), mahogany (*Swietenia machopylia*), *Sengon* (*Albizia falcata*) and Eucalyptus (*Eucalyptus degluputa*). The forests are used under an agro-forestry system (*tumpansari*) and crops tolerant or suitable for shade such as medical crops (ginger and turmeric) are intercropped beneath the canopies of trees. In orchard, various kinds of fruits trees are sparsely planted.

(5) State Forest

The Forest is under the management and control of KPH Surakarta (*Kesatuan Pemangkuan Hutan*/Forest Administration Unit) of Perum Perhutani (State Forestry Company). The state forests in the area are classified into the protected forests and production forests. The protected forests are established in the piedmont areas of Mt. Lawu. The production forests are mostly developed in hilly to mountainous areas. Major trees planted in the forests are merkusi pine (*Pinus merksi*) and other species include *sonokeling* (*Darbegia grandis*), teakwood (*Tectona grandis*), mahogany (*Swietenia machopylia*) and Eucalyptus (*Eucalyptus degluputa*).

However, based on the interpretation of satellite images took in 2003, the current status of the Forest is identified as follows;

Dense forest	201 ha (4%)
Areas interpreted as not in forest conditions	4,826 ha (96%)

Most of the areas interpreted as "not in forest conditions" could be regarded as newly reforested areas based on the information provided by the State Forestry Company.

3.4.2 Land Holding

Access to land holding data at village level is limited to less accurate figures indicated in statistical year book in 2004 and Village potential in 2005 of the selected villages. To provide rough features on land holding status, land holding of farm land in the selected villages are presented in Table 3.4.2 and summarized below.

Table 3.4.3 Distribution of Farm Households by Holding Size in Selected Villages

Items	Range	Average
Holding Size of Food Crops Field		
- Land less	0 ~ 91%	26%
- < 0.5ha	0 ~ 100%	40%
- 0.5 - < 1.0ha	0 ~ 100%	27%
- > 1.0ha	0 ~ 56%	8%

Source: Statistical year book in 2004 and Village potential of selected villages in 2005

As shown in the tables, holding size of food crops field of about 70% of farm households in the selected villages are less than 0.5 ha and those having more than 1.0 ha is limited to 8% as a whole. However, the distribution of farm households by holding size largely differs among villages.

3.4.3 Crop Production

(1) Overall Features

Crop sub-sector agricultural activities in the selected villages are characterized by food

crops production in paddy field (wet land farming) and food and limited scale horticulture and tree crops production in dry land (dry land farming). The wet land farming is practiced mainly in rice terraces constructed on sloping lands. The dry land farming is practiced in terraced fields constructed on moderate to steep sloping lands. The primary crop in the wet land farming is paddy (wet land rice), while in the dry land farming maize and cassava is dominant followed by groundnuts and cultivation of other upland crops is rather limited in extent. The subject crop sub-sector activities of the present Study are the dry land farming practiced for production of seasonal and tree crops.

As the accessibility to village-wise and reliable crop production features is limited, in the present Study, the agricultural information on the selected villages presented in Kecamatan in Figures (Kecamatan dalam Angka, 2004, BPS Wonogiri) and village profiles (*Potensi Desa*, 2005, PMD Wonogiri) are used for the identification of general features on crop production in the selected villages. The said agricultural data are compiled as shown in Table 3.4.4 to 3.4.6.

(2) Wet Land Farming

Paddy production is by far the most important farming activity in the wet land farming, however, palawija production in rotation with paddy is also intensively practiced in off-season(s) or season(s) restricted from water availability. Major palawija in paddy fields in the selected villages is maize followed by groundnut and limited extent of soybeans.

Wet land farming is almost exclusively carried out in irrigated paddy fields. According to the present land use, the area extents of paddy fields in the selected villages are estimated at 11,643 ha or 89% of the total paddy field in Keduang watershed. From the statistical data shown in Table 3.4.6, it could be assumed that about 70 % of the paddy fields are under irrigated.

Cropping Schedules and Patterns:

The basic cropping seasons in paddy fields in the project major kecamatans consist of 3 seasons of MT I (musim tanam I, cropping season I), MT II (cropping season II) and MT III (cropping season III). MT I are from September to November/December and starts waiting for the commencement of wet season. MT II is from December to March; from the peak of wet season to the beginning of dry season. MT III falls in the dry season from April to July. Primary crops cultivated in paddy fields are paddy (wet land rice) followed by maize. Monthly cropped Prevailing cropping patterns in the area are illustrated in Figure 3.4.2. As shown in the figure, the prevailing patterns in irrigated fields are:

Paddy – paddy – paddy	where irrigation water supply through out a year
Paddy – paddy – palawija/fallow	where sufficient watre supply in MT I and II

Cropping patterns in rainfed paddy fields are more diversified and influenced by annual rainfall distribution as shown in the figure. The prevailing patterns could be simplified as follow;

Paddy – paddy – fallow:	where and whsn abundant water supply
Palawija – paddy – fallow:	Pattern common in upland areas

(3) Dry Land Farming

Upland field (*tegal*), upland field in home settlement (*pekarangan*) and, where farming operations are practiced under rainfed conditions (dry land farming), are defined as dry

farmland in the present Study. The extent of the dry farming land in the selected villages is estimated at 13,939 ha or about 90% of the total farm land of 15,752 ha in the Keduang watershed based on the present land use. The ratio of dry farm land/(dry farmland +paddy) shows about 60%. Dry land farming can be characterized with its instability and is extensively practiced in the entire sub-catchment area because of limitation in wet land (paddy field) where more stable farming activities is operated.

The dry farmlands are developed in moderate to steep sloping lands distributing in the area and currently terraces of different protection measures and maintenance conditions are constructed almost in the entire dry farmlands. Land resources of the area are exposed to danger of soil erosion if sufficient vegetative covers are not provided.

Use of dry farmland under multi cropping system (*tumpansari*) composed of maize and cassava is a prevailing farming system in the area, while monoculture of maize and multiple cropping consisting of maize, cassava and groundnut is also practiced in the area. Tree crops are generally planted as components of the multi cropping system and monoculture of the same is seldom recognized. Therefore, accurate features on tree crops planted areas appear are impossible to estimate.

1) Cropping Schedules and Patterns

Cropping season in the dry farmland commences with the on-set of wet season in October/November, while the start of the season varies annually to some extent depending on rainfall distribution in a year. However, the prevailing cropping seasons in the farmland could be defined in to the following 3 cropping seasons.

Table 3.4.7 Prevailing Cropping Seasons in Wonogiri catchment area

Cropping Season	Period	Remarks
1st Season (MT I)	Mid. Oct./Mid. Nov. ~ Mid. Jan./Mid. Feb.	Start with wet season
2nd Season (MT II)	Mid. Jan./Mid. Feb. ~ Mid. April/Mid. May	Minimum tillage
3rd Season (MT III)	Mid. April/Mid. May ~ Mid. July/Mid. Aug.	Very limited

Source: JICA Study Team

Cropping patterns in the areas have been estimated based on the questionnaire survey made to the Extension Coordinators of individual major Keduang kecamatans and findings of field surveys in the present Study. The results are presented in Figure 3.4.3. Based on the same and BPS statistical data on monthly planted areas in dry farmland, the prevailing cropping patterns in the areas could be generalized as shown in Figure 3.4.4 and as follows;

- Almost exclusive multi cropping pattern of seasonal crops is maize + limited density of cassava in MT I, groundnut + cassava (planted in MT I) in MT II and cassava (planted in MT I) in MT III. Population of cassava is limited compared with other areas in Wonogiri catchment,
- Monoculture of maize (maize + limited density of cassava) is also practiced to a limited extent,
- Primary crops in MT I are maize and cassava, those in MT II is groundnut with limited extent of soybeans and maize. Practically no crops except cassava is cultivated in MT III.
- In nearly all dry farmlands, cassava at different densities is planted as an association crop with seasonal crop(s),
- Isolated hills of cassava remain in farm land in MT II with or without seasonal crop (groundnut) and in MT III cassava is only crop left,

- Prevailing cropping patterns in the selected villages are:

Table 3.4.8 Prevailing cropping patterns in the Project Area

Type	Pattern
Pattern 1	MT I: maize + limited density of cassava; MT II and III: limited density of cassava
Pattern 2	MT I: maize + limited density of cassava; MT II: groundnut + limited density of cassava; MT III: cassava
Pattern 3	MT I: Maize + groundnut with very limited density of cassava; MT II: groundnut or fallow + very limited density of cassava; MT III: cassava

Source: JICA Study Team

2) Cropping Intensity

Cropping intensities in dry farmland in the Project Area have been estimated based on the BPS kecamatan level statistical data on monthly planted areas from 2003 to 2005 as shown in Table 3.4.9. The results are summarized in the followings.

- Overall seasonal cropping intensity of dry farmland is estimated at 100% in MT I, 39% in MT II (not including cassava planted area) and 0.05% in MT III (not including cassava planted area), almost same as those in the entire Wonogiri catchment area;
- Cropping intensity in MT II varies depending on kecamatans from 7% to 76% and 39% on average,
- Cropping intensity in MT II is influenced by rainfall distribution in February/March and becomes low in years suffered from drought, and
- Basically no crops are newly planted in MT III.

3) Farming Practices

Prevailing farming practices in multiple cropping systems in the Project Area are mostly as same as that explained in Section 1.2.2 in Chapter 1.

(4) Seasonal Crop Production

For providing rough indicators on crop productions in the selected villages, crop production data from 2001 to 2003 in the major kecamatans in the Project Area are presented in Table 3.4.10 and summarized below.

Table 3.4.11 Production Features of Seasonal Crops in Major Project Kecamatans

Crop	Cropped Area (ha)	Production (ton)	Crop	Cropped Area (ha)	Production (ton)
Paddy	2,025	10,993	Groundnut	1,953	2,288
Upland Rice	57,606	241,666	Soybeans	119	129
Maize	57,606	241,666	Cassava	2,406	34,423

Source: Wonogiri Agriculture Services Office

(5) Fruits and Estate Crops

Major fruits and estate crops grown in the selected villages include mango, coconut, citrus and cashew nut as shown in Table 3.4.5.

3.4.4 Livestock

The livestock sub-sector is providing important income sources for farm economy in the selected villages, especially for the same of dry land farmers. The average holding sizes of livestock per household in 2004 are estimated as shown in Table 3.4.12 and

summarized in the following table.

Table 3.4.13 Holding Sizes of Livestock per Household in the Selected villages

	Cow/Cattle	Goat/Sheep	Poultry
Holding Size per Household (No.)	0.3	1.0	8

Source: Statistical year book in 2004 and Village potential in 2005

Farmers basically raise livestock not for commercial purpose, but animals as assets and draft power and fowls for family consumption. Marketing of animals are made generally through animal markets established at kecamatan level and the rest are traded directly through animal traders at village or kecamatan level.

3.4.5 Forestry

Forest areas in the sub-catchment area are categorized into the state forest (*hutan negara*) and peoples forest (*hutan rakyat*). The state forest is managed and controlled by State Forest Company (*Perum Perhutani*) and the peoples forest is under the control of individual land owners. In the peoples forest, community based forestry development activities are promoted by forestry agencies.

(1) State Forest

The state forest in the Wonogiri watershed is under the management and control of KPH Surakarta (*Kesatuan Pemangkuan Hutan*/Forest Administration Unit). The kabupaten/kecamatan level operations of KPH are executed through BKPH (*Bagian Kesatuan Pemangkuan Hutan*/ Forest Administration Sub-unit) established at watershed levels and field level operations are carried out by RPH (*Resort Pemangkuan Hutan*/Field Unit of KPH) as shown in Figure 3.4.5. In the Keduang watershed area, the state forests extend in the northern and southern fringe of the area. The area extent of the forests is estimated at 5,030 ha in total and 2,050 ha at the right bank and 2,980 ha at the left bank of the Keduang River. The state forests at the left bank are under the control of BKPH Lawu Selatan and Purwantro. The same in the left bank is under BKPH Wonogiri and Purwantoro and there are 5 RPHs established in the Keduang kecamatans as follows;

Table 3.4.14 BKPH Covering State Forest in Keduang sub-catchment Area

Location to Keduang River	BKPH	No. of RPH Related
Left Bank	Wonogiri/Purwantoro	3
Right Bank	Lawu Selatan	3
Left Bank	Purwantoro	2
Total	3 BKPHs	8RPHs

Source: Perum Purhutani KPH, Surakarta

(2) Peoples Forest (Hutan Rakyat)

The people's forests (*hutan rakyat*) are defined as forest areas owned and operated by individuals (villagers/farmers)[11]. The people's forests in the Wonogiri catchment area are classified into two types of: i) forests established under government subsidy or projects (*swadaya perbantu*) and ii) forests established by owner self-help efforts (*swadaya murni*). Majority of the peoples forests in the area are developed by the latter self-help activities.

All the peoples forests in the sub-catchment area are foretasted forests and a greater part of them are managed under an agro-forestry system called tumpansari where multiple planting of trees and seasonal crops are practiced. Dominant tree in the forests is

[11] Reported that no customary or traditionally owned communal forests exist in the Wonogiri watershed.

teakwood. Other tree species planted include: *sengon* (*Albizia falcata*), mahogany, acacia (*Acacia auriculiformis*) and Eucalyptus (*Eucalyotus degluputa*). Predominant accompanying seasonal crops include maize, cassava, beans and medical crops.

The target areas of teakwood forest development under Peoples Forest Program of Gerhan (National Movement for Forest and Land Rehabilitation/*Gerakan Nasional Rehabilitasi Hutan dan Lahan*) in the sub-catchment area are 1,250ha, 1,125ha and 200ha in 2003, 2004 and 2005, respectively. Field observations on the target areas of the program indicate, however, the over density of teakwood reforestation because farmers tend to plant free seedlings supplied by the program in fields already planted with teakwood. In addition, withering of seedlings due to drought is problem of the program yet to be solved.

3.4.6 Agricultural, Forestry and Livestock Support Institutions

Under the district technical services offices of Agriculture Services, Forestry Sub-services and Livestock Sub-services, field staffs or extension staffs are deployed at kecamatan level. The extension services to farmers are basically provided by those field staffs, Field Extension Workers (PPLs) and PPL Coordinators of the Agriculture Service Office, Forestry Coordinator and PKL (Field Forestry Extension Worker/*Petugas Kuhutanan Lapagan*) and Livestock extension worker and inseminator of Livestock Sub-services. The numbers of extension staffs are deployed in the kecamatans Keduang sub-catchment area in 2004 are as shown in Table 3.4.15 and summarized below.

Table 3.4.16 Deployment of Extension Staffs in Kecamatans in Keduang Watershed

Agricultural Field Staffs		Forestry Field Staffs		Livestock Field Staffs	
Coordinator	PPLs	Coordinator	PKLs	Livestock	Inseminator
9	34	8	12	9	7

Source: Agriculture Services and Forestry and Livestock Sub-services, Wonogiri

The Services Offices are constrained with budget limitation and staff capabilities as the cases of other kabupaten level institutions.

3.5 Watershed Conservation Activities in the Selected Villages

3.5.1 Past Watershed Conservation Activities in the Selected Villages

The past watershed conservation activities in the selected villages are represented by the activities under the IBRD Project (Upper Solo Watershed Protection Project; 1988/89 – 1994/95). The activities of the Project in the selected villages are shown in Tables 3.5.1 and 3.5.2 and summarized below.

Table 3.5.3 Programs Implemented in the Selected Villages under IBRD Project

Programs	Programs Implemented in Selected Villages						
	88/89	89/90	90/91	91/92	92/93	93/94	Total
Terrace formation (ha)	495	1,002	1,263	1,806	723	-	5,288
Small gull plug (Nos.)	181	259	212	304	-	-	956
Gully head structure (Nos.)	25	49	51	58	-	-	183
Big gully plug (Nos.)	41	39	12	9	-	-	101
Check dam	8	10	0	2	-	-	20
Sloping grass (m^2)	24,723	38,265	19,430	26,703	-	-	109,121
Road side protection (m^2)	0	22,079	7,525	0	0	0	29,604
River bank protection (m^2)	391	910	0	0	0	0	1,301

Source: files of the Governor office

3.5.2 Current Watershed Conservation Activities in the Selected Villages

The current watershed conservation activities in the selected villages are represented by the activities under Gerhan (National Movement for Forest and Land Rehabilitation; 2003 - 2007). The Gerhan activities in the selected villages from 2003 to 2006 are shown in Table 3.5.4 and summarized below.

Table 3.5.5 GERHAN Programs Implemented in Keduang Watershed from 2003 to 2005

Programs	Programs Implemented in Selected villages			
	2003	2004	2005	Total
Peoples Forest	1,250 ha	1,125 ha	200 ha	2,575 ha
Check Dam	-	1 unit	2 units	3 units
Gully Plug	21 units	-	10 units	31 units
Small Gully Plug			25 units	25 units
Absorption Well	27 units	4 units	40 units	71 units
Small Reservoir	-	1 unit	-	1 unit

Source: LHKP Wonogiri

As the Keduang watershed area was selected as a priority area of the project for mitigating sedimentation in the Wonogiri Reservoir, a larger proportion of programs were implemented in the area.

3.6 Estimate of Soil Loss from the Surface

3.6.1 General

Annual average soil loss form the Keduang watershed is estimated using the Universal Soil Loss Equation (USLE). All the conditions for calculation of annual average soil loss such as rainfall erosivity factor, soil erodibility factor, slope length factor, crop management factor, and support practice factor were used as same as that used in Section 1.4.2 in Chapter 1.

3.6.2 Annual Average Soil Loss

Annual average soil loss form the Keduang watershed is calculated at 4.79 million tons/year as shown in the following Table 3.6.1

Details of annual average soil loss and annual average soil loss/ha for each village are shown in Tables 3.6.2 to 3.6.3 and illustrated on Figures 3.4.1 and 3.4.2.

Table 3.6.1 Present Annual Average Soil Loss in the Keduang Watershed

Land Categories	Annual Average Soil Loss (1,000 ton/year)
(1) Paddy field	11
(2)Settlement area	
(i) Home settlement area	957
(ii) Settlement area under upland field condition	1,698
(3) Upland field	1,465
(4) Orchard and plantation	363
(5) Forest	11
(6) State forest land*	
(i) forest land	5
(ii) other	264
(7) Other land use	4
Total	4,778

Source: JICA Study Team

3.7 Constraints and Key Issues for Watershed Conservation and Management

3.7.1 Constraints for Watershed Conservation and Management

Present conditions and problems on land and soil management, agricultural issues and farmers and social issues in the Keduang sub-catchment area are similar to those identified in the Wonogiri catchment area in the Master Plan Study. Major causes attributed to such problems are presented in Table 3.7.1 in detail and issues of specific importance to the Keduang watershed are enumerated in the followings.

- Most of dry farm land, including those susceptible to erosion on steep slopes, developed for dry farm lands (*tegal* and *pekarangan*) are used for seasonal crops production and partly for perennial crops and tree planting; degradation of dry farm lands results in increased susceptibility to erosion of the land,
- Almost entire dry farm land on sloping lands have been terraced with different protection and stability statuses and such terraces are not always formed and maintained as recommended,
- Vegetative covers in dry farm land are largely governed by those of seasonal crops; remarkable changes from bare - maximum cover - bare, and vegetative covers by seasonal crops limited in critical period of February to March in MT II,
- Farmers general preference for seasonal crops to perennial crops because poverty may cause farmers to use most of their land for crops to be readily converted into food/cash,
- Overall seasonal cropping intensity of dry farm land: 100% in MT I, 39% in MT II and 0% in MT III,
- Soil moisture conservation practices such as mulching are seldom practiced and application of organic fertilizer limited,
- Proper forestry management is not introduced yet; over population, no fertilization, no selective cutting etc since extension activities primarily directed to forestation and not to forestry management, and
- Most farmers have small farms, capital and lack of bargaining power and result in

limited agricultural intensification and income; force young people leave village and migrate to urban areas; next generation less interested in farming.

3.7.2 Key Issues for Watershed Conservation and Management

The past efforts for the watershed conservation in the Wonogiri catchment area are represented by 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 watershed conservation were continued in a limited scale by utilizing district, provincial and national budget. In 2003, GERHAN scheduled for the period from 2003 to 2007 was lunched and activities for the conservation in the catchment area have been restored to a substantial degree. The key issues to be duly addressed in the formulation of the conservation measures in the sub-catchment area are enumerated in Table 3.7.2, which are similar to those identified for the Wonogiri catchment area in the Master Plan Study through the study on the present conditions/problems and causes and lessons learned. The specific issues to be dully addressed in the formulation of watershed conservation plan are as follows;

- The comprehensive development of a basin so as to make productive use of all its natural resources of soil, water and vegetative resources and also protect them is termed "watershed management" and could be envisaged through integrated and collaborated activities for watershed conservation,
- Emphasis on agricultural approaches as agricultural lands occupying majority of the subject areas and farmers accounting for almost all target groups of measures. Most causes of erosion are attributed to agricultural activities and most of erosion control measures are also closely related with them,
- Introduction of tree crops presents effective measures for soil erosion. However, types of agro-forestry should be determined based on comprehensive study on natural and socio-economic conditions since there will be certain competition between forestry and agricultural uses of land,
- Link between poverty and poor management of dry farm land left being less attended due to farmers seeking for off-farm income in the cities should be addressed to an extent possible. Therefore, packages of conservation measures and improved agricultural practices must provide adequate and immediate and long term financial gains to farmers for ensuring positive participation of dry land farmers, and
- In the catchment area, farmers holding size is limited and measures will become a dispersed manner with limited effects when measures are introduced individually only by interested farmers. Therefore, community based introduction of measures is to be envisaged, which dictate understanding and agreement of a number of small scale farmers. Local people are the most important factor in good watershed management and resources development. Therefore, community should take a leading role for the watershed conservation from the stage of planning and collaborative activities of all stakeholders, community and implementing agency for the implementation of the conservation are essential.

CHAPTER 4 WATERSHED CONSERVATION PLAN

4.1 Basic Concepts and Approaches

The annual average soil loss in the Keduang watershed is estimated at 4.79 million tons, most of which comes from the lands surface (agricultural lands). The soil loss from off-farm areas such as landslides, riverside soil erosion and gullies is very small. As previously mentioned, the main erosion sources are uplands, uplands in the settlement areas and the settlement areas and the most urgent objective is soil erosion control for these areas.

The local peoples in the Keduang watershed understand that the crop yields are seriously affected by degradation of soil fertility due to soil erosion and are keenly interested in soil conservation. The results of the survey made it clear that an increase in the agricultural incomes of the local farmers as practitioners is essential.

In order to solve such urgent objectives, it is necessary that watershed conservation be promoted by considering of the approaches from the view points of ; (1) water/soil conservation. (2) agricultural issues and (3) socio-institution

As soil textures in the watershed is very fine, the construction of the large-scale Sabo dams is not seen as an economical or functional solution for soil erosion control. So these structures will not be included in this Study. In this Feasibility Study, (1) Introduction of improved bench terrace, which is very effective for soil erosion control as the results of soil erosion tests carried out in the Keduang watershed. (2) In addition, soil conservation will be made by reinforcement of terrace risers and lips by covering with grasses. (3) Agro-forestry systems will be introduced for soil erosion control, improvement for agricultural productivity and transfers of agricultural productivity improvement and agricultural income sources to the future generations. (4) Soil conservation based on the introduction of improved technology on water/soil conservation, appropriate cropping patterns, crop yield and soil management should be made. (5) Furthermore, hedgerow and side ditches will be used for soil erosion from the fringe of the settlement areas. (6) Various support programs are included for smooth and effective performance of the projects will be made by hedge row and construction of side ditches.

Most of the watershed projects in the Wonogiri watershed were conducted by introducing a top-down system, but it is said that these projects did not produce the benefits expected. (1) Basically, a community based down-top system will be adopted in this plan. The plan is that local peoples should participate from the planning stage to monitoring stage after implementation. Work of socialization will be carried out by NGOs and governmental officers and consultants will assist technical issues. (2)It is very important to guarantee the transparency of all the project activities including capital for smooth implementation of the project. For this purpose an implementation committee should be instituted. (3) Considering the low benefit in the short term from the agriculture improvements in the project, the proper incentives should be introduced for the beneficiaries. Materials and farm inputs necessary for the project will be entirely subsidized. About 20-50% of the labor charge for construction will be subsidized.

Details of the approach to the project in Keduang watershed conservation project are mostly as the same as mentioned in Sections 2.2.1-2.2.3 in Chapter 2.

4.2 Classification of Subject Areas and Target Areas

4.2.1 Classification of Subject Area

The planned subject area for the Keduang watershed conservation project consists of the lands consisting of uplands, uplands in the settlement areas and the settlement areas.

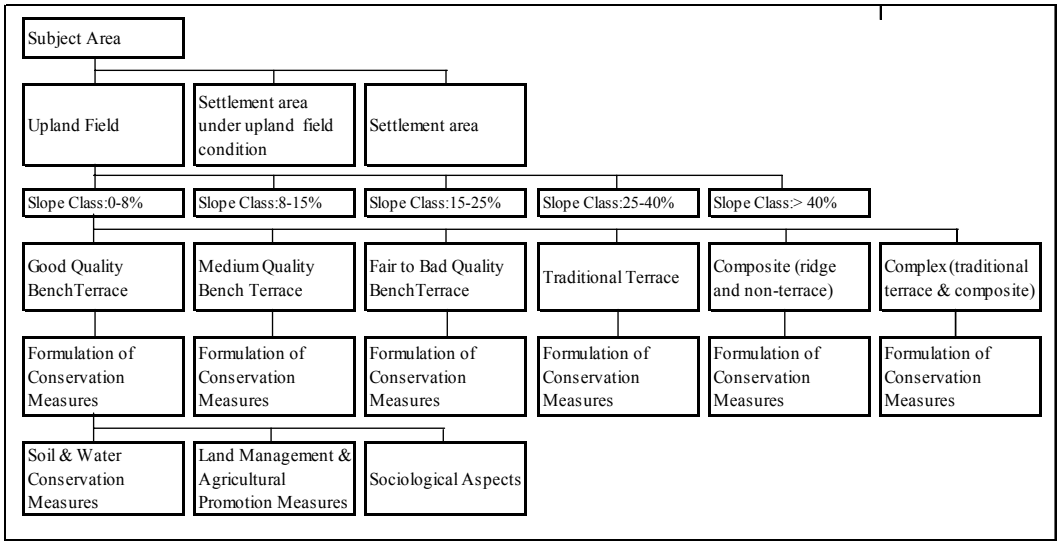
The factors of USLE that could be managed or mitigated through watershed conservation measures are P factor (land conservation factor) and C factor (vegetative/cultivation factor). Accordingly, for the formulation of the watershed conservation measures, the subject areas have been classified into sub-units (land units) in order to facilitate formulation of a conservation plan composed of soil/water conservation measures and agricultural measures. The land conservation factor which could be the target for soil and water conservation measures is the terrace type and its condition. The vegetative/cultivation factor which could be the target under the 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 4.2.1 Classification Criteria of Subject Area

Factor	Classification Criteria	Code
Land Use	Upland Field	U
	Upland in the Settlement Area (Pekarangan) 1/	P
	Housing Yard 2/	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
	Complex (traditional terrace and composite)	T6

1/: Settlement area under upland field condition 2/: 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 4.2.1 Classification of Subject areas into land unit for Formulation of conservation Countermeasures

Based on the classification criteria for subject area, coding of land unit in subject area was shown in the following Table.

Table 4.2.2 Coding of Land Units in Subject Areas

Terrace Type and Condition	Slope Class (%)				
	0-8	8-15	15-25	25-40	>40
Upland Field					
- Good Quality BT 1/	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 2/	US1T5	US2T5	US3T5	US4T5	US5T5
Settlement area under Upland Field Condition					
- Complex (traditional terrace and composite)	PS1T6	PS2T6	PS3T6	PS4T6	PS5T6
Housing Yard	HS1	HS2	HS3	HS4	HS5

Source: JICA Study Team
1/: BT = bench terrace 2/: Association of ridge and non-terrace

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 as shown in the following table.

4.2.2 Target Areas for Watershed Conservation Project

The target areas for the Keduang watershed were selected from the subject areas mentioned above based on the following procedures.

- The Keduang watershed conservation project is carried out with the people in the local community's peoples (villages) as practitioners. The boundary map of villages in Keduang watershed was prepared based on the topographic maps on a scale of 1/25,000 made by BAKOSURTANAL. Village names and areas of village areas were identified.
- All the information and data necessary for estimate of soil loss were collected and input to the GIS system that was made in this Study.
- Annual average soil loss for each village within the Keduang watershed was calculated. Then the villages with more than 100 ha in area and/or annual average soil

loss per ha of over 50 tons/ha/year, were screened for the Keduang watershed conservation.

- For each of the villages screened 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 the villages with a total annual average soil loss per ha from the three kinds of areas of less than 50 ton/ha/year, were excluded from the target areas.
- With respect to the proposed land use depending on slope classes (Refer to Table 4.3.4), the rate of introduction of the perennial fruits trees/trees (agro-forestry) was planned as 50% as shown in Table 4.3.7**.**
- Implementation of terrace improvement and terrace formation/upgrading works was planned for 100% of the total subject areas of less than 25% in steepness, 80% for the total subject areas of the terrace rehabilitation works with 25-40% in steepness and 60% for the subject areas with over 40% from the viewpoint of access conditions to the sites, difficulties of terrace construction due to deep roots of big trees, very steep topographic conditions, uncertain farmers` intention about terrace making, etc.
- Implementation for settlement areas (housing yards) by planting shrub at a fringe of the village was planned as 60% of the total settlement areas.
- The State Forest area in the Keduang watershed is excluded from the target subject areas in this watershed conservation project.

The target areas for watershed conservation in Keduang watershed are about 11,100 ha as shown below. The total number of selected villages in the Keduang watershed is 82. The number of villages based on Kecamatans is shown below.

Table 4.2.3 Selected Villages in Kecamatan

Name of Kecamatan	Number of villages selected
Girimarto	12
Jatipurono	11
Jatiroto	10
Jatisrno	15
Ngadirojo	6
Nguntoronadi	1
Sidoharjo	12
Slogohimo	14
Wonogiri	1
Total	82

Source: JICA Study Team

List of the selected villages and annual average soil loss and soil loss per ha are shown in Table 4.6.3 and 4.6.2 in Section 4.6.

Table 4.2.4 Target Area for Watershed Conservation for Keduang Watershed

Land use			Code of land	Area (ha)	Land use	Code of land	Area (ha)
Upland Field	Bench terrace	good	US1T1	0	Uplands in settlement area (complex)	PS1T6	1,520
			US2T1	0		PS2T6	1,765
			US3T1	0		PS3T6	1,039
			US4T1	0		PS4T6	394
			US5T1	0		PS5T6	365
			sub-total	0	sub-total		5,083
		medium	US1T2	0	Settlemt area	HS1	0
			US2T2	6		HS2	569
			US3T2	8		HS3	372
			US4T2	7		HS4	185
			US5T2	3		HS5	270
			sub-total	24	sub-total		1,396
		fair/poor	US1T3	0			
			US2T3	984			
			US3T3	1,027			
			US4T3	870			
			US5T3	1,392			
			sub-total	4,273			
	Traditional terrace		US1T4	3			
			US2T4	40			
			US3T4	33			
			US4T4	26			
			US5T4	71			
			sub-total	173			
	Composite (ridge and non terrace)		US1T5	1			
			US2T5	9			
			US3T5	31			
			US4T5	44			
			US5T5	82			
			sub-total	167	Total		11,116

Source: JICA Study Team

4.3 Proposed Watershed Conservation Plan

The proposed basic watershed conservation measures consist of: i) soil conservation measures of physical and vegetative measures, ii) agro-forestry development and iii) farming support programs. The target areas of the measures are upland fields, upland fields in settlement area and settlement area as discussed earlier. The basic directions applied, in the present proposed watershed conservation plan, for individual land units being classified by slope classes and current terrace type and condition are presented in Table 4.3.1 and 4.3.2 and briefly discussed in the followings.

4.3.1 Soil Conservation Measures

For planning soil conservation measures the cost for the watershed conservation should be minimized and the project works should be easily carried out by beneficiaries of the project. The proposed soil conservation measures consist of physical measures of terrace improvement and construction works and side ditches in the settlement area, and vegetative measures for vegetating of the terrace lip, riser and fringe of home settlement (housing yard) with grass or shrub for their stabilization as shown in Table 4.3.3.

Table 4.3.3 Proposed Soil Conservation Measures

Measures	Components
Physical Measures	Bench Terrace Improvement/Construction Works - Terrace bench improvement or construction - Terrace lip improvement - Terrace riser improvement Improvement of waterway and drop structure
	Improvement of side ditch in settlement
	Improvement of side ditches in the settlement area
Vegetative Measures	Lip stabilization (Bench terrace and ridge terrace) Riser stabilization Hedge row at fringe of housing yard

Source: JICA Study Team

The dimensions of standard designs for the major works are shown below:.

Table 4.3.4 Dimension of Major Works

	Terracing				**Drain**	**Lip**	**Riser**	**Drop**
Land gradient (%)	Average gradient (%)	Height of a terrace (m)	Nr. of terrace (nr/ha)	Width of a terrace* (m)	Width of bench drain (m)	Width of a lip (m)	Slope length (m)	Height of drop (m)
0-8	4	0.6	6.67	14.99	0.25	0.20	0.63	0.6
8-15	12	0.7	17.14	5.83	0.25	0.20	0.73	0.7
15-25	20	0.8	25	4.00	0.25	0.20	0.84	0.8
25-40	33	1.0	33	3.03	0.25	0.20	1.04	1.0
>40	50	1.0	50	2.00	0.25	0.20	1.04	1.0

*: slope= 1:0.3

	Waterway				**Lateral drain of side ditch**		**Collector drain of side ditch**	
Land gradient (%)	Catchment area (ha)	Height of drain (m)	Interval (m)	Nr. of drain (nr./100m)	Width of canal (m)	Interval (m)	Width of canal (m)	Interval (m)
0-8	4-5	0.2	75	1.33	-			
8-15	3-4	0.2	75	75	0.4	200	0.2	100
15-25	2-3	0.2	75	75	0.4	200	0.2	100
25-40	1-2	0.2	75	75	0.3	200	0.2	100
>40	0.5-1	0.2	75	75	0.3	200	0.2	100

Source: JICA Study Team

Varieties of vegetative measures and various plants for the stabilization of bench terrace were or have been introduced in the past or current watershed conservation projects and activities in the watershed area. Aiming at accommodating such experiences into the formulation of the present study, vegetative measures in the past have been assessed. 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[12]. Details of the assessment are presented in Table 4.3.5. As indicated in the table, in case of

1: The measures and plants employed for individual target areas in the 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.

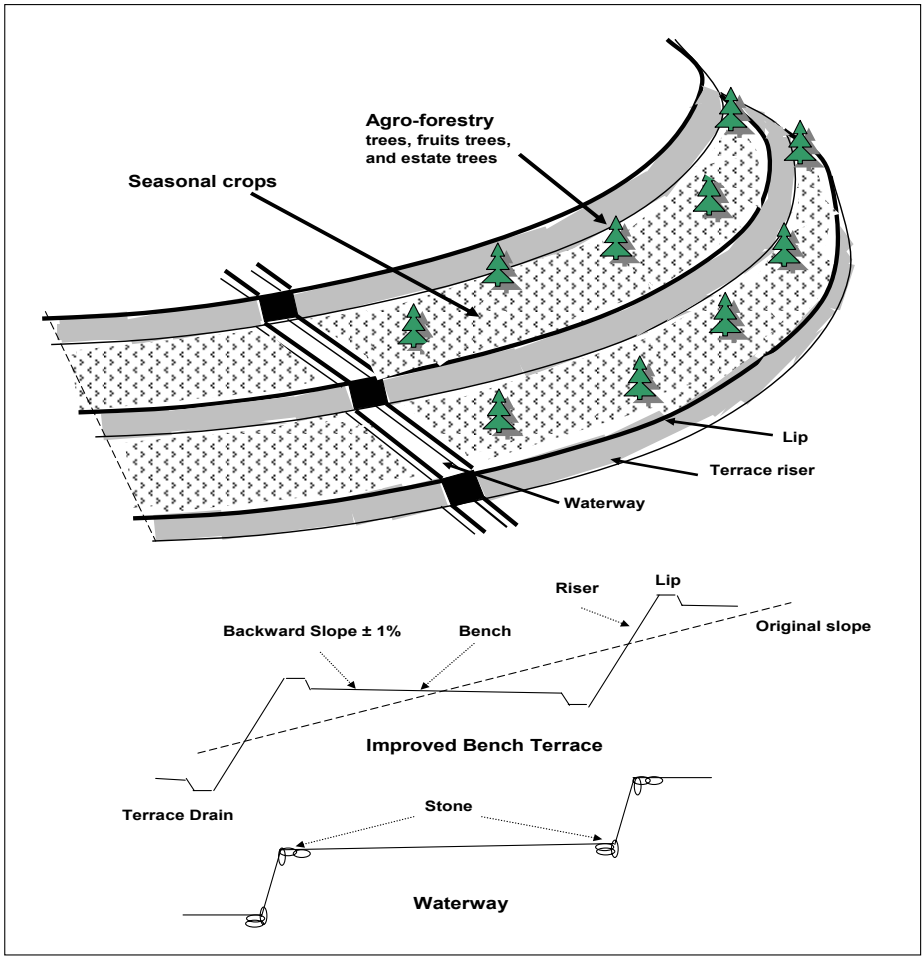
grass, farmer's preference or fodder value of plant appears to be an essential factor for selection. The following table indicates the recommended varieties for stabilization of lips, risers and hedgerow at the fringe of housing yards.

Table 4.3.6 Basic the 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
Housing Yard1/	Hedge row	Shrub	Flemingia congesta Roxb etc.

1/: Housing yard in home settlement;
Source: JICA Study Team

The image of an improved bench terrace is illustrated as shown below.



Source: JICA Study Team

Figure 4.3.1 Image of Improved Bench Terrace

4.3.2 Agro-forestry Development

The agro-forestry development will be introduced into uplands and uplands in the settlement areas. The basic direction for the proposed 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 labor burden in future farming activities through the expansion of fruit/estate crops cultivation to meet gradual aging of farming communities and tendency for seeking non-farm job opportunities of next generation.

The direction set for the proposed land use depending on slope classes of areas is as shown in the following table. The rate lf the introduction of perennial crops/trees are determined taking into consideration the farmer's intention. 50% of the figure proposed by the Indonesia Government was taken.

Table 4.3.7 Slope Classes and Agro-forestry Development

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

Source: JICA Study Team

Selection of crops/trees to be introduced in the agro-forestry development was made principally based on the assessment that Wonogiri Agricultural Services Office made on the adaptability of trees and perennial crops (fruits and estate crops) for the project kecamatans. Details of assessment study are shown in Tables 4.3.8 and 4.3.9.

The recommended trees and perennial/estate crops for the agro-forestry development are teaks, Sonokeling, Merkusi pine, Mahogany, Eucalyptus, Sengon, Bamboo, Mango, Durian, Rambutan, Cashew nut, Clove, Cacao, Mlingo, Citrus and so on.

Furthermore, inter-cropping with medicinal crops such as Termeric, Ginger, etc will be introduced into the agro-forestry areas where the slope steepness is over 15% in order to increase farm income.

4.3.3 Farming for Vegetative Measures

Basic farming for vegetative and agro-forestry measures is principally based from the data Pola Penanganan Erosi dan Sedimentasi Dengan Pembangunan Hutan Rakyat Kabupaten Wonogiri, 2005[13] and presented in Table 4.3.10.

4.4 Support Program for Promoting Watershed Conservation Projects

4.4.1 Support Program for Promoting Watershed Conservation Projects

The proposed soil and water conservation measures are approaches having direct and immediate effect on soil conservation and support programs for practitioner farmers should be included to ensure these benefits are realized. 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 staffs providing technical guidance and support to farmers and farmer groups is an essential initial and periodical step to be taken for the efficient and successful implementation of the measures. The program description is shown in Table 4.4.1.

[13] Study report prepared by Faculty of Forestry, Gajah Mada University & LHKP, Wonogir

(1) Farmers and Farmer Groups Empowerment Package Program

The package program aims at formation and empowerment of farmer groups by supporting for formation of beneficiary farmer groups and providing technical guidance to farmers and farmer groups as a preparatory stage for the implementation of the conservation measures. Accordingly, the program is composed of: i) a farmer group formation program and ii) a farmer group empowerment program. In addition, a needs assessment of target farmers should be made for the formulation of a definite plan for conservation measures as follows;

Farmer Group Formation Program

- Farmer group formation (socialization/workshop and support for formation)

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 and trees to be introduced in the proposed measures

(2) Package Program for Operation/Implementation of Conservation Measures

The package program aims at providing technical and financial support for beneficiary farmers or practitioners and consists of: i) Terrace Formation Guidance Program, ii) Agro-forestry Development Program and iii) Field Guidance Program as follows;

Terrace Formation Guidance Program

- Technical guidance on proposed soil and water conservation measures
- Support package for provision of grasses/trees for terrace stabilization
- Labor cost subsidy for physical measures (terrace improvement/ formation/upgrading works)

Agro-forestry Development Program

- Technical guidance on agro-forestry development
- Provision of support package (seedlings and farm inputs) for agro-forestry development envisaged in the proposed measures

Farming Support Program

- Technical guidance on farming system improvement
- Provision of soil ameliorant and farm inputs

Field Guidance Program

- Inception technical guidance and support to beneficiary farmers and farmer groups
- Follow-up technical guidance and support

(3) Field Staff Empowerment Program

The program is to provide induction and periodical refresher training or technical guidance for field staffs involved in the implementation of the proposed measures as explained in Table 4.4.1.

4.4.2 Support Programs for Land Management and Agricultural Promotion

The support programs are formulated with the aim of strengthening of 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 snf 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 as shown in Table 4.4.1.

Technology Development Program

- Research extension dialog team
- Sample Trial and adaptability trial

Demonstration Program

- Demonstration plot for improved farming
- Cropping pattern demonstration for improved cropping patterns

Pilot Demonstration Field of tree Crops/trees

- Village operated demonstration activity on agro-forestry development under guidance of technical and research agencies

Farmer and Farmer Group Training Program

- Farmer and farmer group training program
- Mass Guidance/Campaign/workshops

Palawija Seed Production Program

- Palawija seed production program
- Seed campaign

Strengthening of Logistics Support for Extension Activities

- Kecamatan level
- District level

4.4.3 Support Programs for Community Development

The support programs are formulated aiming at empowerment of village people and organizations. The support programs consist of: i)Village Action Plan (VAP) for soil conservation, ii) Establishment of Implementation Committee, iii) Guidance for Village Grant and iv) Education program are shown in Table 4.4.2. The outlines of the village grant fund and education program on watershed conservation are shown in Tables 4.4.3 and Table4.4.4, respectively.

(1) Village Action Plan (VAP) for Soil Conservation

Implementation of village assessment

Formulation of VAP

- Formulation of draft VAP
- Discussion with executing agency
- Finalization MOU for VAP
- Conclusion of MOU for VAP

(2) Establishment of Implementation Committee

Election of Committee member

(3) Guidance for Village Grant Fund

Formulation of Fund Use Plan

- Explanation of guideline
- Formulation of draft plan

- Consensus building

Agreement with Executing Agency

-Conclusion of agreement for the fund

Operation the Fund

- Provision of fund
- Follow-up technical guidance and support

(4) Education Program

Preparation Materials

Implementation of Special Lecture and Campaigns

4.5 Project Works

The project works for the Keduang watershed conservation project are shown in the following table. Project works will be performed by introduction of the farmer's participation system. Works such as cutting/filling, excavation, masonry and vegetation planting will be shared by the Government and beneficiaries of the project. All the materials necessary for the project such as farm inputs and construction material will be purchased by the Government.

Table 4.5.1 Project Works for Keduang Watershed Conservation Project

Items		Total Project Work
1. Land preparation		
1) Terracing	unit:	
(1) Cutting and filling	1,000m^3	4,673
2) Waterway and drop		
(1) stone material	1,000m^3	44
(2) Excavation	1,000m^3	62
(3) Masonry work	1,000m^3	40
3) Lip and rizer, planting		
(1) Seedling, grass for lip	1,000nr.	838,585
(2) Seedling, shrub for lip	1,000nr.	5,032
(3) Seedling, grass, for rizer	1,000nr.	115,938
(4) Planting work, for lip	1,000m	25,158
(5) Planting work, for rizer	1,000m^2	23,188
2. Side diches (for housing yard)		
1) Side ditch		
(1) Stone material	1,000m^3	20,000
(2) Excavation	1,000m^3	29,000
(3) Masonry work	1,000m^3	18,000
2) Headgerow		
(1) Shrub, for hedger row	1,000nr.	4,467
(2) planting work, hedge row	1,000m2	558
3. Agro-forestry and annual crops		
1) Agro-forestry and annual crops	Ls	Ls
4. Support program	Ls	Ls
1) Support program		
Source: JICA study team		

4.6 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) hedgerow works, vi) side ditch construction works, and vii) other support programs for land management and agricultural

promotion. After implementation of the project, all the present uplands consisting of upland field with bench terrace, traditional terrace area, uplands with composite and uplands in settlement areas will become uplands with improved bench terrace. Agro-forestry development will be made in some of the improved terrace lands. Except for the settlement areas, soil amelioration will be carried out under the farming support program. Hedgerow works and construction of side ditches will be provided for some settlement areas.

Reduction of soil loss in the Keduang watershed is expected after implementation of the watershed conservation projects. The water conservation projects will be carried out about 11,100 ha of the target area as mentioned in section4.2.2. The soil loss in the Keduang watershed after implementation of the watershed conservation projects is estimated by USLE.

The parameters used calculation of soil loss production after implementation of the project, are shown below.

Table 4.6.1 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

Based on the above parameters, the annual average soil loss in the entire Keduang watershed is estimated and shown in the following tables. After the implementation of the projects, it is estimated that the soil loss will be reduced about 1.8 million tons per year from the Keduang watershed as following tables:

Table 4.6.2 Reduction of Annual Average Soil Loss in Keduang Watershed

Land Categories	Annual Average Soil Loss (1,000 ton)		Reduction of Annual Average Soil Loss (1,000 tons)
	Present condition	After implementation	
(1) Paddy field	11	11	0
(2) Settlement area			
(i) Home settlement area	957	849	108
(ii) Settlement area under upland field condition	1,698	803	895
(3) Upland field	1,465	751	714
(4) Orchard and Plantation	363	363	0
(5) Forest	11	11	0
(6) State forest land*			
(i) forest land	5	5	0
(ii) other land use	264	176*	88
(7) Other land use	4	4	0
Total	4,778	2,973	1,805

Remarks : *: This annual average soil loss is estimated and assumes that 90% of the other land use in the state forest land will be reforested.
Source : JICA Study Team

Details on annual average soil loss and annual average soil loss /ha over the entire Keduang watershed after implementation of project on the villages are shown in Tables 4.6.3 and 4.6.4.

Details on annual average soil loss production and annual soil loss /ha at a village level under present conditions and after implementation of the project on villages are illustrated are in Figures 4.6.1 and 4.6.2

It may be concluded from the above table that 38% (1,805/4,778) of the total annual average soil loss at present is trapped or reduced after implementation of the project.

4.7 Project Cost Estimate

As mentioned in section 4.5, it is planned that part of the project works will be done by voluntary labor force contribution from the beneficiaries in the Keduang watershed Conservation project as follows:

Table 4.7.1 Sharing rate for Project Works

Item	Share rate (%)	
	Government	Beneficiaries
Cutting and filling work	75	25
Excavation work	75	25
Masonry work	75	25
Planting work	50	50
Materials and farm inputs	100	0

Source: JICA Study Team

The project cost is estimated as only the costs that the government will share. The estimated project cost is about US$13.3 million as below.

Table 4.7.2 Project Costs for Keduang Watershed Conservation Project

	unit	Unit cost ($)	Q'ty (1,000)	Amount (1,000$)
I Direct Cost				
1. Land preparation				
1) Terracing	unit:	unit cost		
(1) Cutting and filling	m^3	0.69	4,673	3,224
2) Waterway and drop				
(1) stone material	m^3	8.48	44	373
(2) Excavation	m^3	0.58	62	36
(3) Masonry work	m^3	10.64	40	426
3) Lip and rizer, planting				
(1) Seedling, grass for lip	nr.	0.01	83,858	839
(2) Seedling, shrub for lip	nr.	0.07	5,032	352
(3) Seedling, grass, for rizer	nr.	0.0015	115,938	174
(4) Planting work, for lip	m	0.01	25,158	252
(5) Planting work, for rizer	m2	0.02	23,188	464
2. Side diches (for housing yard)				
1) Side ditch				
(1) Stone material	m^3	8.48	20	170
(2) Excavation	m^3	0.58	29	17
(3) Masonry work	m^3	10.64	18	192
2) Headgerow				
(1) Shrub, for hedger row	nr.	0.07	4,467	313
(2) planting work, hedge ro	m2	0.02	558	11
3. Agro-forestry and annual crops				
1) Agro-forestry and annual crops			Ls	3,075
4. Support program				
1) Support program			Ls	1,099
Total Direct Cost				11,017
II Government Administration and Engineering Service Cost				
(11% of total direct cost)				1,212
III Physical Contengency				
(10% of total cost of **I** and **II**)				1,223
Grand total				13,452

Source: JICA Study Team

4.8 Benefit

The anticipated positive benefits of the proposed watershed conservation project on agriculture in the Keduang watershed are multiple. 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 present study, benefits on crop sub-sector from the project have been estimated.

4.8.1 Assumptions

(1) 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 without project

conditions as follows: With maize cultivation, varieties of maize are different depending on the locality. It is used in this study that hybrid maize varieties prevail into the uplands having slope steepness of 0-25%, while composite maize varieties into the uplands having slope steepness of over 25%. Because the steep uplands do not provide conditions to introduce highbred maize varieties in the steep areas due to poor management of soil farming and terrace lands.

Table 4.8.1 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

(2) With Project Cropping Pattern

It is assumed that proposed cropping patterns under with project condition are made for the uplands classified by 5 groups of slope steepness. The details are as shown in Table 4.8.2. After the implementation of the project, all the uplands will be equipped by the improved bench terrace. Afterwards, soil erosion will be prevented from the uplands, resulting in decreasing of soil fertility. The beneficiaries in of 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 will not be changed drastically. With project condition, improved varieties of seasonal crops and agro-forestry crops will be introduced. With respect to maize and ground nuts, hybrid maize varieties and improved ground nut varieties will be planned to be grown in all the uplands. The areas cultivated by cassava is planned to be decreased based on areas cultivated by agro-forestry crops. As mentioned in Section 4.3.2, 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. Selection of crop varieties will be chosen by beneficiaries as one pleasures.

It is also planned that inter-cropping of maize under agro-forestry crops can be cultivated up to 4th year after the beginning of planting of agro-forestry crops. Afterward, maize could not be grown because canopy of agro-forestry crops become enough large to prevent sun light into the ground.

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

4.8.2 Benefit

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

Benefit is estimated based on the following procedure:

- Calculation of net return of crop/ha by preparing crop budgets /ha for each crop in the conditions of with and without project conditions

- Calculation of net return/ha for each uplands based on 5 slope classes and cropping pattern/cropping intensity in the conditions of with and without conditions
- Calculation of total net return of the total net area in with project condition and without condition
- Calculation of benefit as difference between total net return in with project condition and without condition.

(1) Economic Benefit

Economic benefit is estimated on the basis of border parities price for farm inputs such as urea, TEP and KCL and shadow price (0.75) for unskilled labor.

Economic crop budgets for seasonal crops are prepared in Tables 4.8.3 and 4.8.4. Economic average crop budget of fruit trees and estate crops for agro-forestry is shown in Table 4.8.5. Details of crop budget for each crop and tree are shown in Tables 4.8.6, 4.8.7, 4.8.8, 4.8.9, 4.8.10 and 4.8.11. Economic profit per ha for seasonal crops and agro-forestry crops is shown in Table 4.8.12. Total economic benefit from Keduang Watershed Conservation Project from 1st development year to 15th development year is estimated as shown in Table 4.8.13 and summarized below;

Table 4.8.14 Total Economic Benefit from Keduang Watershed Conservation Project

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	3,506~4,174
Over 40%	-2,551~-471	892~5,541	5,498~6,918
Total benefit	-594~2,615	2,524~9,669	16,909 ~20,251

Source: JICA Study Team

(2) Financial Benefit

Financial benefit is estimated on the basis on present prices of materials, crop production, labor and so forth. Only hired labor is taken for estimate of financial benefit.

Financial crop budgets for seasonal crops are prepared in Tables 4.8.15 and 4.8.16. Economic average crop budget of fruit trees and estate crops for agro-forestry is shown in Table 4.8.17. Details of crop budget for each crop and tree are shown in Tables 4.8.18, 4.8.19, 4.8,20, 4.8.21, 4.8.22 and 4.8.23. Economic profit per ha for seasonal crops and agro-forestry crops is shown in Table 4.8.24. Total economic benefit from Keduang Watershed Conservation Project from 1st development year to 15th development year is estimated as shown in Table 4.8.25 and summarized below;

Table 4.8.26 Total Financial Benefit from Keduang Watershed Conservation Project

Slope Classification	Benefit (Rp.million)		
	1st – 4th year	5th – 10th year	11th – 15th year
0-8%	1,104~1,328	1,089~1,581	1,656~1,716
8-15%	1,921~2,573	1,296~3,955	4,320~4,581
15-25%	-1,016~487	-141~2,980	3,475~3,836
25-40%	--823~423	713~3,484	3,495~4,252
Over 40%	-2,725~-473	976~5,668	5,309~6,974
Total benefit	-1,540~4,338	3,933~17,668	18,225~21,359

Source: JICA Study Team

As shown in the tables, the net returns from the land use under the proposed agro-forestry development as a whole in the period of 15 years in any slope classes, the incremental net returns are expected:

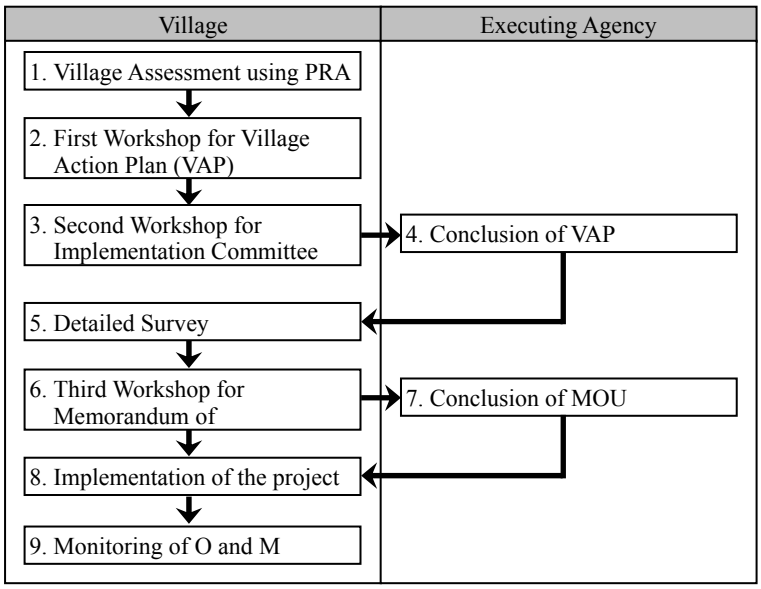
However, the decreases of net returns in the initial stage of the proposed agro-forestry awdevelopment are noticed in all cases except for a slope class 0 - 15%. Especially, the deceases are serious in slope classes over > 15% where the land use intensities of tree crops/trees are higher. Such situations dictate the necessity of provision of support programs in the implementation of the proposed agro-forestry development under the present study.

4.9 Implementation Plan and Proposed Implementation Arrangement for Watershed Conservation Projects

4.9.1 Implementation Plan

(1) Procedure

Local people will be the most important factor in good watershed conservation and management. Considering participatory manner to be made by the community and local people, it will be important that, i) people's understandings for the soil conservation through PRA and other surveys, ii) people's initiative through preparation of village action plan (VAP) and formulation of implementation committee, iii) responsibility share between exacting agency and village through formulation of Memorandum of understanding MOU. Therefore, the following nine steps as procedure are proposed in the following figures.



Source: JICA Study Team

Figure 4.9.1 Implementation Procedure

The detailed explanation of each step is already explained in Section 2.3, Implementation plan and proposed implementation arrangement for watershed conservation projects.

(2) Implementation Schedule of Watershed Conservation Project

The total target area for Watershed Conservation Project is 11,116 ha. The project works consist of i) socialization and planning, ii) implementation of terracing, waterway, lip and riser grassing, side ditches and hedge row and iii) support programs for promoting watershed conservation projects/support programs for land management and agricultural promotion. The implementation of the project is carried out on the basis of the followings.

- All the works should be made at village basis, since the implementation committee will handle the works with technical assistance of the executing agency.
- To avoid the conflict amongst villages, the project should implement in all the villages located in the same sub-watershed as much as possible.
- Socialization and planning will be carried out on the village level (total number of 82 villages).
- Implementation of terracing, waterway, lip and riser grassing, side ditches and hedge row will be carried out by farmers themselves (Soil and water conservation farmer group, K2TA explained in next Section) under the guidance of Support Team (Consultant and NGO).
- Implementation of terracing, waterway and side ditches will be principally carried out during the dry season.
- Grassing for lips and terrace risers, and agro-forestry development should be at the onset of the wet season.
- Labor availability in 82 villages in the target area for Keduang watershed conservation project is considered.
- The experience of the implementation in the World Bank Project (Upper Solo Watershed Protection Project in Wonogiri Watershed) is considered as reference.

Based on the above approach, the implementation schedule is set as follows.

Major Work Item	Year						
	2007	2008	2009	2010	2011	2012	2013
1 Financial Arrangement							
2 Sediment Storage Reservoir							
Detailed Design							
PQ and Tender							
Construction							
3 Watershed Conservation in Keduang Watershed							
Socialization and Planning							
Implementation							
Supporting Program							
4 Procurement of Dredger							
Design							
Manufacturing							
Installation							

Source: JICA Study team

Figure 4.9.2 Implementation Schedule for Watershed Management

4.9.2 Proposed Implementation Arrangements at Field and Village Level

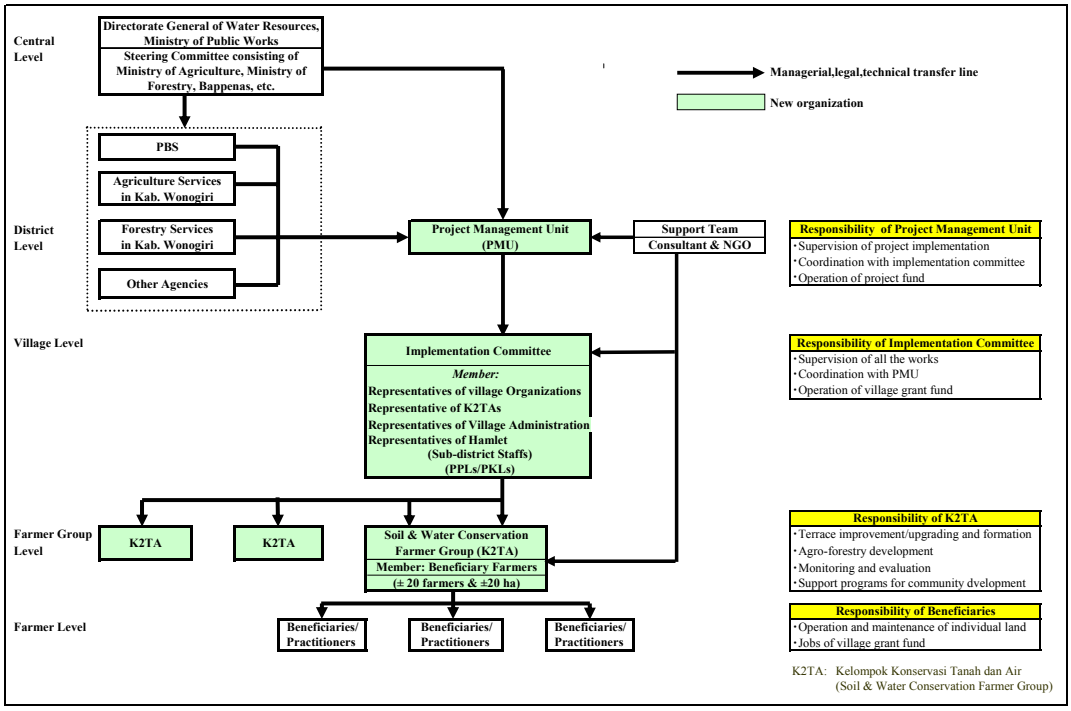
(1) Organizational structure

In the watershed area, farmers holding size is limited and measures will become a dispersed manner with limited effects when measures are introduced individually by interested farmers. Therefore, community based introduction of measures is to be envisaged, which dictates understanding and agreement on proposed measures by a number of 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 a responsible role for the proposed watershed conservation as practitioners from the stage of planning and collaborative activities of all stakeholders, communities and implementing agencies, for the implementation of the conservation are essential.

The proposed organization set-up at field level and village level for the implementation is shown in Figure 4.9.3. 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 member of implementation committee should be selected with transparency in the beginning of the implementation under the guidance and support of the executing agency and Support Team (consultants and NGOs). The member of the Implementation Committee will consist of the representatives of village organizations, representative of K2TAs, the representatives of village administration and the representative of hamlets.

The formation of the farmers groups so called as Kelompok Konservasi Tanah dan Air (K2TA; Soil and Water Conservation Farmer Group) under the Implementation Committee will be made and empowerment to these groups will be made. Such formation of K2TA is to be executed in a year prior to the implementation of conservation measures. Following the formation of K2TA, K2TA empowerment program should also be implemented in the 1st year.

After such a preparatory stage in the 1st year, terracing works consisting of physical and farming support program and agro-forestry development are to be implemented from the 2nd year.



Source: JICA Study Team

Figure 4.9.3 Proposed Organization for Implementation of the Project

(2) Role and Responsibility amongst Stakeholders at Village Level

The role and responsibility amongst stakeholders at village level are proposed as follows.

Table 4.9.1 Role of Stakeholders Concerned

Component	Executor	Supervisor	Supporter
(1) Terracing	K2TA	Implementation Committee	Extension staffs (PPL/PKL) and PMU
(2) Village Grant Fund	Village people	Implementation Committee	PMU and Support Team
(3) Monitoring and Evaluation	K2TA	Implementation Committee	PMU and Support Team
(4) Support Programs for Soil and Water Conservation Measures	Extension staffs (PPL/PKL) and Consultant	Implementation Committee	PMU
(5) Support Programs for Land Management and Agricultural Promotion Measures	Support Team	PMU	-
(6) Support Programs for Community Development	K2TA and other village organizations	Implementation Committee	PMU and Support Team

Note; PPL: Agricultural field extension worker, PKL: Forestry field extension worker, PMU: Project Management Unit
Source: JICA Study Team

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

Table 4.9.2 Responsibility of Stakeholders Concerned

Stakeholders	Responsibility
Farmers	Operation and maintenance of individual land
K2TA	Terracing, terrace improvement and upgrading
Implementation Committee	Supervision of all work, coordination with PMU, and operation of village grant fund
Extension staffs (PPL/PKL)	Technical training and guidance to K2TA
Consultant	Technical training and guidance to Extension staffs
Project Management Unit	Supervision of project implementation, coordination with Implementation Committee, and operation of project fund

Note; PPL: Agricultural field extension worker, PKL: Forestry field extension worker, PMU: Project Management Unit
Source: JICA Study Team

4.9.3 Monitoring and Evaluation at Village Level

The monitoring and evaluation (M and E) at village level are formulated aiming at empowerment of village people and organization for feedback and project modification. The M and E works as empowerment approach should include: i) supervision of the works by the village, ii) project impact analysis by the village, iii) necessity modification of project based on the project evaluation, and iv) knowledge building based on lesson and learn from the project. The summarized below:

Table 4.9.3 Summary of MandE 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