Part I
Master Plan Study


KEY MAP
KALIMANTAN
SULAWESI
Jakarta
JAWA SEA
INDIAN OCEAN
JAWA
PROJECT AREA
SCALE
0 5 10 15 20 25 30 km
N
Mt. Merbabu
3142
Mt. Merapi
2914
Boyolali
SURAKARTA
Cemara River
Bengawan Solo
Sragen
Sragen River
Sawur River
Mungkung River
Grompol River
Ngawi
Ketonggo River
Mt. Buntung
742
Mt. Pandan
897
Jerowat River
Brambang River
Gawe River
Mt. Lawu
3265
2298
MADIUN
Gondang River
Catur River
Samin River
Jlantah River
Klaten
Dengkeng River
Colo Weir
Walikan River
Madiun River
Gonggang River
Asin River
Mt. Wilis
2563
Mungkungan River
Wonogiri
Slogohimo
Ngadirojo
Jatisrono
Wonogiri Multipurpose Dam
Wuryantoro
Keduang River
Tempuran River
Ponorogo
Keyang River
Anyar River
Eromoko
Tirtomoyo River
Batuwarno
Temon River
Bengawan Solo
Baturetno
Alang River
Pracimantoro
Giriwoyo
Pacitan
Indian Ocean
Legend
Watershed
River
Wonogiri Dam
Railway
Road
Mountain
City
Town
Provincial Boundary
Location Map
BENGAWAN SOLO
SCALE
0 15 30 45 60 75 90 km
KEY MAP BENGAWAN SOLO

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

FINAL REPORT

VOLUME II MAIN REPORT

Part I: Master Plan Study

Table of Contents

List of Tables

List of Figures

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The Wonogiri Multipurpose Dam is the only large dam on the mainstream of the Bengawan Solo River, aiming at flood control, irrigation water supply and hydropower generation. The Bengawan Solo River, which flows through Central and East Java Provinces, is the largest river in Java Island with a catchment area of around 16,100 km^2 and a length of about 600 km. The Wonogiri dam was constructed in 1981 under the technical cooperation of OTCA (the former JICA) and financial assistance of OECF (the former JBIC). Impoundment of the reservoir was initiated on December 29, 1980 and the reservoir was filled about one year later.

View of the Wonogiri Dam Reservoir

Various irrigation development projects and river improvement works have been so far implemented in the Bengawan Solo River basin under the technical and financial assistance of Japan. In the Wonogiri Dam catchment, about 90% of the total land has been cultivated with dry-land farming that is categorized as highly fragile to surface soil erosion. Forests cover only 10% of the catchment. These values indicate a high population density in the catchment. The Wonogiri reservoir has been rapidly filled with sediments transported from the catchment. Poor land use of its catchment and intensive farming of annual crops using poor practices on the highly erosive and steep-sloped uplands as well as highly populated and intensely farmed areas are the main causes of the sedimentation of the Wonogiri reservoir. A preliminary assessment of the current state of sedimentation indicated that the effective reservoir capacity has decreased to nearly 60% of the original one. It could be said that, provided that any countermeasure is not taken for the sedimentation problem of the Wonogiri Reservoir, it would lose its functions such as water supply, flood control because of decrease of the storage capacity in the near future. Especially, the intake structure that feeds water to the powerhouse and downstream irrigation system has been seriously affected by sediment deposits at and around the intake structure. There was a fear that the intake structure be completely clogged with sediments.

To cope with the sedimentation problem of the Wonogiri reservoir, the Government of Indonesia (hereinafter referred to as the "GOI") requested the Government of Japan (hereinafter referred to as the "GOJ") to implement the grant aid project. The request covered i) construction of two check dams on the Keduwang River close to the dam to mitigate sediment inflow into the reservoir, ii) urgent sediment dredging in front of the intake structure in order to assure the stable and continuous water supply, and iii) providing a permanent dredging system to allow sustainable maintenance dredging of sediment deposited in front of the intake.

The "Project on Urgent Countermeasures for Sedimentation in the Wonogiri Multipurpose Dam Reservoir" commenced in June 2001, but it aimed at only dredging of sediment of about 250,000 m^3 deposited at and around inlet channel and portal portions of the intake structure so as to keep the proper functions of the intake structure for about 5 years. This was mainly due to the consideration that less effect on trapping fine sediments by check dams and high operation and maintenance cost of a dredger. This grant aid project was completed in February 2004 emphasizing the urgent necessity to formulate a master plan on countermeasures for sedimentation problems of the Wonogiri reservoir including its watershed conservation plan. However, it was just an urgent measure to prevent the intake from clogging by the sediment deposit. In order to recover the storage capacity of the reservoir, fundamental permanent countermeasures should be established and implemented.

Under such condition, the GOI officially requested the GOJ to provide the technical assistance to formulate a master plan as a continuation of the grant aid project in August 2002. In response to the request, the GOJ decided to conduct the Study on Countermeasures for Sedimentation in the Wonogiri Multipurpose Dam Reservoir (hereinafter referred to as "the Study" or "this Study"). Hence, the Study was commenced in August 2004.

1.2 Objectives of the Study

The objectives of the Study are to:

i) Formulate a master plan for sustainable countermeasures for sedimentation problems in the Wonogiri Multipurpose Dam Reservoir,
ii) Conduct a feasibility study of the selected priority project(s), and
iii) Transfer technology to counterpart personnel in the course of the Study.

The goals after achievement of the above objectives are to:

i) Implement the project to be proposed under the Study to secure the long-term ability of the reservoir to supply water for irrigation and hydropower generation, and
ii) Provide solutions and technical approaches for reservoir sedimentation problems, which are of increasing concern in Indonesia.

1.3 Study Area

The Study Area covers; i) the entire catchment of the Wonogiri dam (reservoir area of 90 km^2 and remaining catchment area of 1,260 km^2), and ii) downstream reaches of the Bengawan Solo River from the Wonogiri dam to the confluence with the Madiun River, as shown in a Location Map attached at the beginning of this Report.

1.4 Scope and Schedule of the Study

(1) Scope of the Study

The Study was carried out in accordance with the 'Scope of Work' which was agreed between the DGWR and the JICA Preparatory Study Team on March, 2004 (See VOLUME-V SUPPORTING REPORT III, ANNEX 17). The Scope of Work describes that the Study carries out in two phases, namely Phase I and Phase II. The Scope of Study in each phase is as follows:

<u>Phase I: Formulation of Master Plan</u>

1. Ensuring the function of the water intake of the Wonogiri dam

- Sediment removal system

2. Countermeasures for sedimentation of the whole Wonogiri reservoir
   - Watershed conservation
   - Structural countermeasures
   - Operational countermeasures
3. Institutional plan
   - Operation and maintenance plan of the Wonogiri dam and watershed conservation facilities
   - Institutional strengthening plan of watershed management and the Wonogiri dam management
   - Financial plan of watershed management and the Wonogiri dam management
4. Cost estimation
5. Project evaluation
6. Selection of master plan project
7. Implementation schedule
8. Monitoring and evaluation plan
9. Selection of priority project(s) for feasibility study

Phase II: Feasibility Study on the Selected Priority Project(s)

1. Verification test and its technical evaluation
2. Preliminary design of facility(s)
3. Operation and maintenance plan of facility(s)
4. Project cost estimation and financial analysis
5. Project implementation plan
6. Project evaluation

(2) Schedule of the Study

The Study will be carried out in accordance with the work schedule shown in Figure 1.4.1 below. Total duration of the Study is scheduled to be 36 months starting in August 2004 and ending in July 2007. The schedule of the Study may be changed according to the selected priority project(s).

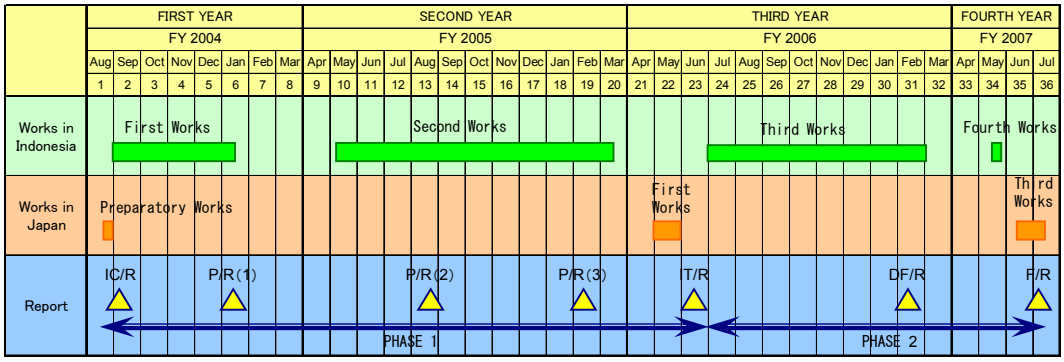


Figure 1.4.1 Overall Schedule of the Study

1.5 Study Organization

(1) Executing Agency

Executing agency for the Study at the national level is the Directorate General of Water Resources (DGWR) of the Ministry of Public Works (PU).

At the site level, the Bengawan Solo River Basin Development Project（PBS）acts as the

counterpart agency.

(2) Steering Committee and Technical Working Groups

For proceeding with the Study effectively and smoothly, a Steering Committee and a Technical Working Groups have been organized. The Steering Committee, composed of central government agencies concerned with the Study, supervises the overall activities of the Study. The Technical Working Groups, composed of central and regional government agencies, monitor the progress, discuss issues and support the Study. 'Minutes of Meetings on the Scope of Work' signed on March 9, 2003 states that the committees will be composed of the representatives from the following organizations:

Table 1.5.1 Member Agencies of Steering and Technical Working Groups

Steering Committee	Technical Working Groups
a. Ministry of Public Works b. BAPPENAS (National Planning Board) c. Ministry of Forestry d. Ministry of Home Affairs e. State Ministry of Environment f. Ministry of Agriculture	Watershed conservation a. Ministry of Public Works, represented by DGWR b. Ministry of Forestry c. Ministry of Home Affairs d. State Ministry of Environment e. Central Java Province f. Wonogiri District Sediment removal system and structural countermeasures for sediment in Wonogiri Dam a. Ministry of Public Works, by DGWR b. State Ministry of Environment c. Bengawan Solo River Basin Development Project d. PJT I e. Central Java Province f. Balai PSDA Bengawan Solo

Source: JICA Study Team

(3) JICA Advisory Committee

JICA has organized an Advisory Committee. The Committee provides technical guidance and advices to JICA at milestone stages of the Study. The member list of the Advisory Committee is shown in Table 1.5.2.

(4) Study Team Organization

The Study Team comprises sixteen (16) experts and one coordinator. The composition of Study Team is shown in Table 1.5.3.

(5) Counterpart Personnel

In the First and the Second Field Works, totally 34 counterparts were assigned for the Study from the agencies concerned. Although some counterparts were provided part-time basis, positive participation of counterpart personnel was made. Especially, PBS undertook active involvement in study activities through co-working in the same Study office as well as at occasions of the workshop and joint meetings. The list of counterpart personnel is shown in Table 1.5.4.

(6) Organizational Arrangement

The organization setup for the Study is schematically shown below.

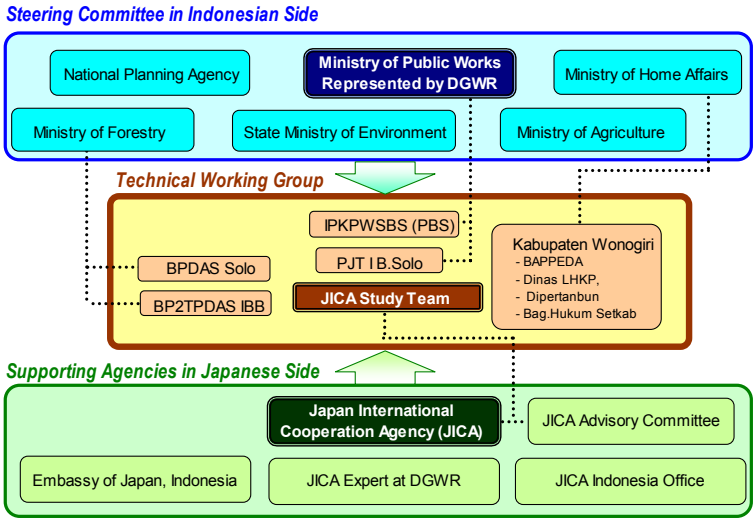


Figure 1.5.1 Organizational Arrangement for the Study

1.6 Final Report

This Final Report is hereby submitted as the final product of the Study since the beginning of the Study in July 2007. This Final Report comprises two parts:

Part I Master Plan Study

Part II Feasibility Study

The Master Plan was established in the Interim Report in June 2006 as the final product of Phase I of the Study. The proposed Master Plan was explained and discussed at the Steering Committee meeting, chaired by Director General of Water Resources, Ministry of Public Works, held at Jakarta twice on July 4 and 19, 2006, and approved by the Steering Committee.

After the approval of the proposed Master Plan, Phase II of the Study was commenced as the Third Field Works in Indonesia for the feasibility study on the proposed urgent countermeasures and ended in July 2007. The outcome of Feasibility Study was explained and discussed at the Steering Committee meeting, chaired by Director General of Water Resources, Ministry of Public Works, held at Jakarta twice on February 27 and May 30, 2007, and approved by the Steering Committee.

The Final Report consists of the following volumes:

Volume I	Executive Summary
Volume II	Main Report
Volume III	Supporting Report I
Volume IV	Supporting Report II
Volume V	Supporting Report III
Volume VI	Data Book
Volume VII	Collection of Photographs

CHAPTER 2 PRESENT CONDITION OF THE STUDY AREA

2.1 Socio-Economic Condition

2.1.1 Summary

This Section 2.1 discusses the socio-economic conditions of the Wonogiri Multipurpose Dam Project area (hereinafter referred to as "the Project area"), including:

i) The Wonogiri dam watershed area, represented by kabupaten Wonogiri, and
ii) The Wonogiri irrigated area, represented by kabupaten Karanganyar, Sukoharjo, Klaten, and Sragen.

Figure 2.1.1 presents a location map of kabupatens in the Project area. The data presented in this Section 2.1 supports the argument that the Wonogiri Dam has contributed significantly to the development and people's welfare of the Project area. It is therefore worth while making all efforts necessary to maintain the functions of the Wonogiri dam for the sustainable development of the future generations.

The benefits of the Wonogiri dam are distributed unequally between the irrigated area and watershed area. The socioeconomic data shows that this unequal distribution of the benefits results in unequal level of economic development. It can be observed in pronounced differences in the economic structure and performance, employment, income level and structure, etc. Table 2.1.1 shows the summary of socio-economic data for the Study Area.

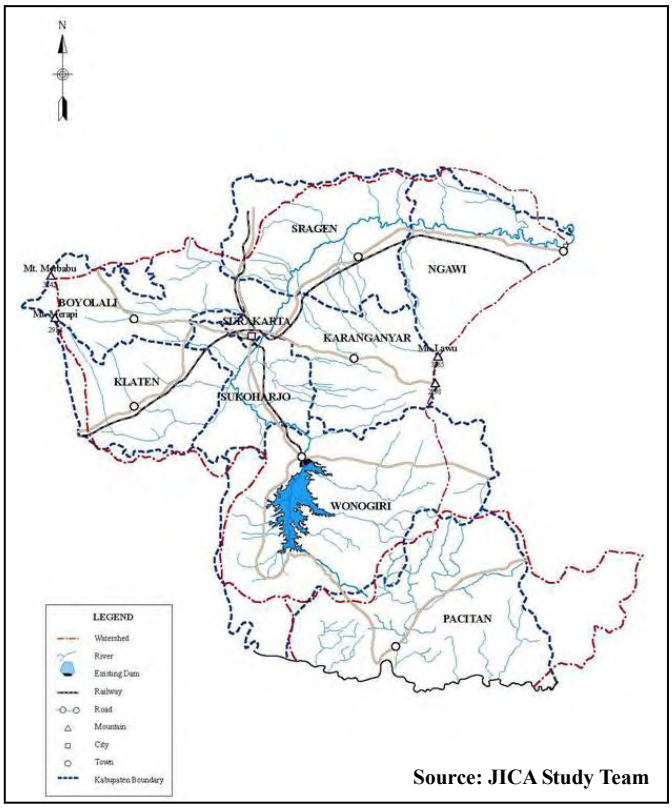


Figure 2.1.1 Location Map of Kabupatens in Project Area

2.1.2 Development Plans

The development plans in Indonesia that are concerned with the Project area are discussed in the following Paragraphs of (1) to (3):

(1) Twenty-Five Year Long Term Development Plan (PJP)

Until 1979, a greatest emphasis was given to increasing rice production and self-sufficiency through rehabilitating and expanding irrigation/drainage facilities. After 1979, the policy goals included intensification programs for dry season crops (maize and soybean), with the goal of balancing production and consumption of the major food crops. From 1989, the focus shifted to improving sector efficiency, consolidating rice productivity gains, and diversifying crops. The agriculture sector was expected to absorb unemployed and eradicate poverty.

For water resources, the PJP II is focusing on sustainable development, more effective, efficient and integrated management of water resources. There is a continuous emphasis on the self-sufficiency in rice production.

The major achievements of the first PJP I (1969-1993) and targets of the current PJP II (1994-2019) are summarized below:

Table 2.1.2 Twenty-Five Year Long-Term Development Plan (PJP I and PJP II)

Item	PJP I (1969-1993) Results	PJP II (1994-2019) Targets
1. Population growth	1970s: 2.3% 1990s: 1.6%	2019: 0.88%
2. Average annual economic growth	6.8%	7.0%
3. Per capita income	1968: USD 70 1994: USD 650	2019: USD 2,600
4. Average life expectancy	1968: 45.7 years 1994: 62.7 years	2019: 70 years or more
5. Elementary school attendance	1968: 41% 1993: 100%	

Source: PJP I and PJP II

(2) Five-Year National Development Program (PROPENAS)

The first Five-Year National Development Program (PROPENAS 2000-2004) is based on decentralization policy in all aspects of national development. It stressed the poverty reduction, increase of employment opportunities, regional development, protection of water resources, empowerment of local administrations and water users, transfer of water resources infrastructure, river basin management, etc.

Table 2.1.3 Five-Year National Development Plan (PROPENAS 2000-2004 and PROPENAS 2005-2009)

Item	PROPENAS (2000-2004) Targets	PROPENAS (2005-2009) Targets
1. Population growth	Lower than 1.51%	
2. Average annual economic growth	4-5% in 2000 6-7% in 2004	5.5 % in 2005 7.6 % in 2009
3. Per capita income	USD 760 in 2000 USD 1,312 in 2004	
4. Unemployment	6.2% in 2000 5.1% in 2004	9.5% in 2005 5.1% in 2009
5. Population in poverty	Decrease population in poverty by 4% from 1999	16.6% in 2004 8.2% in 2009

Source: PROPENAS 2000-2004 and PROPENAS 2005-2009

(3) Regional strategic plans (RENSTRA) set by the regional and local governments under the regional autonomy rules

Kabupaten Wonogiri follows the regional development plan (RENSTRA 2006-2010) that is shown in Table 2.1.4 below.

Table 2.1.4 RENSTRA 2006-2010 Kabupaten Wonogiri

Strategic Aim	Goals 2010
Socio-economic empowerment	- Poor population < 24% - End shortage of clean water - Unemployment < 2.1%

Strategic Aim	Goals 2010
	- Improve education (illiterate < 5%, elementary > 95%, junior high school >80%, senior high school > 65%) - Improve health (life expectancy > 68 years, malnutrition <0.6%, access to heath facilities >90%)
Law & politics	- Increase community participation (>80% voting in local elections)
Religious	- Development of local culture - Harmony religious quality
Community, government, improving competitiveness	- Agriculture growth > 3% - Infrastructure: district roads in good condition > 65%, village roads in good condition > 75%, irrigation canal > 70% - Critical land < 5.25%, people forest > 19% - Local tourism growth > 10% per year - Kabupaten income increase >10% per year; good governance

Source: RENSTRA 2006-2010 Kabupaten Wonogiri

The RENSTRA 2006-2010 does not explicitly mention the erosion and soil protection problems. Nevertheless, it includes some projects related to the soil conservation of relevant agencies.[1] This plan translates into the annual plan (REPEDA).

2.1.3 Population

Table 2.1.5 Population and Population Density between 1971 and 2004

Location	Population (x 1,000 people)		Population Density (person / km^2)	
	1971	2004	1971	2004
Indonesia	120,149	241,974	59	119
Central Java Province	21,877	32,397	671	996
Wonogiri watershed area	852	1,007	503	553
Wonogiri irrigated area	2,631	3,632	4,001	5,454

Source: Jawa Tengah in Figures 2005; Dalam Angka, Central Java 1971, SUSENAS 2004 ; for 2005, based on recent Populaiton Census.

Note: (i) Wonogiri irrigated area is represented by data for kabupaten Karanganyar, Sukoharjo, Klaten and Sragen; (ii) Wonogiri watershed area is represented by data for kabupaten Wonogiri.

In 2004, the total population in Central Java Province was recorded at 32.4 million, which is about 15% of the total population in Indonesia, as informed by the National Socio-Economic Survey 2004. The inhabitants of the Wonogiri watershed area (corresponding to kabupaten Wonogiri, 1,007 thousand people in 2004) accounted for about 3.1% of the total population of Central Java Province. The inhabitants of Wonogiri irrigated area estimated at 45,200 households of kabupaten Karanganyar, Sukoharjo, Klaten and Sragen in Central Java Province.

The average annual population growth of Indonesia during the period of 1990-2000 was 1.49% (0.94% for Central Java Province), while the Population Census confirmed annual growth rate is 1.45% in 2005. The population growth slowed down as compared with the average annual growth rate of 2.42% for the period of 1971-1980 and 1.95% for the period of 1980-1990 (1.17% in Central Java). The general decrease happened mostly due to the family planning programs. The population growth is reflected by the increasing population density as shown in the table above.

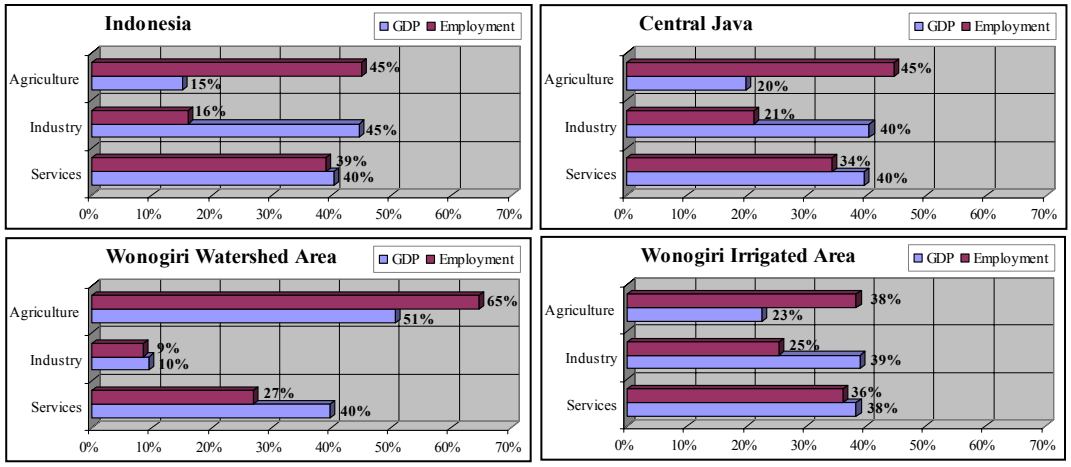
Indonesia is experiencing a strong trend of urbanization. In 1980, only 22.3% of all Indonesians lived in the cities (18.7% in Central Java Province). In 1990, 30.9% and in 2000 already 42.0% people lived in urban areas. For Central Java Province, the ratio was 27.0% in 1990 and 40.4% in 2000.

[1] Same situation as in previous RENSTRA 2002-2005

In the Wonogiri dam watershed area (represented by kabupaten Wonogiri), the similar trends are observed. The out-migration of people to cities is very intensive, especially over the last years. The local administration explains the out-migration trend as a cause of the lack of the sufficient off-farm employment opportunities and deteriorating conditions for agriculture (lesser rainfall over the last few years). In 2003, about 1,378 people left kabupaten Wonogiri. Consequently, the total population of kabupaten Wonogiri is not increasing over the last years[2], even though the population of the Province is growing as a whole at annual average of 0.94% for 1990-2000. The Wonogiri watershed area is the least densely populated as compared with the whole Central Java Province and the Wonogiri irrigated area.

2.1.4 Economic Structure

Indonesia has a well-balanced economy in which all major sectors play an important role. The country is abundant in mineral resources, which have been exploited rapidly over the past three (3) decades, enabling the mining sector to contribute to the balance of payment. Agriculture (including animal husbandry, fishing and forestry) has historically been the major engine of economic growth and source of employment. In 1969, agriculture sector contributed the biggest share of GDP (36.8%) and grew at an average annual rate of 3.8%, which is above the population growth of 2.4%. With the rapid growth and economic transformation, the agricultural share in GDP declined to 19.4% in 1990, while the manufacturing and industry share in GDP increased from 28.8% in 1969 to 34.4% in 1989. Recently, the services sector has expanded (in 2004 it accounted for 40% of GDP and employed over one third of the working population). However, in the Wonogiri dam watershed area, the agriculture sector still prevails, both in terms of GRDP and employment.



Source: Central Java in Figures, 2005, Statistik Sosial dan Kependudukan Jawa Tengah 2004; GRDP Kabupaten Wonogiri 2005; BPS 2005

Figure 2.1.2 GRDP and Employment by Sector, 2004

As shown in the above figure, the Wonogiri irrigated area follows the pattern of Central Java Province and Indonesia. This is endorsed by the fact that the GRDP is generated by the services and industry (40% and 40% share, respectively, in Central Java, and 38% and 39% in Wonogiri irrigated area). Agriculture sector accounts for the remaining 20% of GRDP in Central Java and 23% in the Wonogiri irrigated area. Like other parts of Java,

[2] Habitants of kabupaten Wonogiri: in 1993: 1,047.5 thousand people, in 2003: 1,112.8 thousand people, in 2004: 1,007.4 thousand people (according to "Central Java Social Statistics" and "Central Java in Figures"; however "GRDP kabupaten Wonogiri" for 2004 gives the population number of 1,115.1 thousand people).

Central Java Province is moving forward from agricultural economy to manufacturing industry and service economy.

However, the Wonogiri dam watershed area is still heavily dependant on the agriculture, both in terms of GRDP (50% share) and employment (65% of labor force). This is attributed to underdeveloped industries (only about 10% of share in GRDP and employment), while the share of services sector in GRDP and employment is comparable with that in the Wonogiri irrigated area and the whole Central Java Province.

2.1.5 Economic Performance

(1) Indicators of Economic Performances

In 1969[3], Indonesia was one of the poorest countries in the world, with the GDP per capita of only about US$ 50. At that time, the GDP was growing at the rate of 6-7% annually and the agriculture sector was the main one contributing to the GDP growth (30%) and employment, providing jobs and income for about two-third of the population.

At present, BAPPENAS is forecasting the following economic performance indicators.

Table 2.1.6 Main Economic Indicators between 2005 and 2009

Economic Indicator	2005	2006	2007	2008	2009
Macro Indicators					
Inflation, CPI [%]	7.0	5.5	5.0	4.0	4.0
Exchange Rate, Nominal [Rp./US$]	8,900	8,800	8,800	8,700	8,700
GDP Growth by Expenditures [%]					
Economic Growth	5.5	6.1	6.7	7.2	7.6
Investment	14.6	17.8	16.3	14.3	12.8
Balance of Payment					
Current Account/ GDP [%]	1.6	0.5	0.1	-0.2	-0.5
Foreign Reserves [USD billion]	36.8	36.0	35.6	35.2	35.9
GDP					
GDP per capita [Rp. 000]	7,946	8,333	8,791	9,317	9,914
Fiscal Sustainability					
Budget Deficit/ GDP [%]	-0.7	-0.6	-0.3	0.0	
Tax Revenue/ GDP [%]	11.6	11.6	11.9	12.6	13.6
Debt Stock/ GDP [%]	48.0	43.9	39.5	35.4	31.8
Open Unemployment					
% of Work Force	9.5	8.9	7.9	6.6	5.1

Source: BAPPENAS; 2005 (5-Year National Development Program: PROPENAS 2005-2009)

(2) Inflation

The main concern on the economy in 2006 is the inflation. In January 2006, the year-to-year inflation was at 17.03%; the core inflation (excluding volatile prices, such as food, and regulated prices, such as utility rates) was 9.68%. The high level was caused by the high oil prices. The Government officially announced that administered prices (especially electricity tariff) will be raised in the first quarter of 2006. Therefore, the forecast for inflation should be revised.[4] The inflation is likely to slow down in 2007 as global oil prices ease.

(3) GDP Growth

The overall growth is positive and rising, although below Indonesia's long-term average.

[3] The times of the First 25-Year Long Term Plan (PJP-I 1969-1993) and the feasibility study for the Wonogiri Dam.
[4] According to the estimates of the Bank of Indonesia: rise in electricity prices by 30% is causing 0.9% point increase of inflation rate; consequently, the BI forecasted rate of inflation for 2006 for 8%

The Government is projecting 6.6% average growth between years 2005-2009. However, in 2005, the economic growth rate is as low as 5.6% as compared with the target (since private consumption and investment slowed down due to high inflation and interest rates). It is expected that the real GDP will actually grow at average 5.9% in 2006-2007, revealing the recovery in investment demand (the Government plans to make investments in infrastructure development as a compensation for the fuel price rise). Meanwhile, almost all the current GDP growth actually comes from consumption. Investment, which was at 30% of GDP before the Asian crisis, has fallen to about 20%. Indonesia needs as much as Rp.1.3 quadrillion (about USD 139 billion) between 2005 and 2009 to improve its infrastructure, of which the Government can only cover 20% and hopes that the rest will come from private sectors.[5]

The main issue at present is to lift economic growth and investment to create jobs, as the unemployment is very high (employment is described in the following subsection 2.1.6). During the crisis, the fall in rupiah and the rise in interest rates made many businessmen unable to pay their creditors. Many companies went bankrupt, which threw people out of work. The resulting fall in purchasing power and demand for consumer goods accelerated the downward spiral. The employment in manufacturing has also been shrinking since 2000 because many exporters have left due to the crisis.

Central Java Province has little natural resources such as gas/oil resources, timber or minerals. To sustain its economic growth from 1960s, it had to capitalize on its strengths such as large population and geographical diversity. Manufacturing industry in Central Java has grown steadily but remains behind that of Jakarta/ West Java and East Java, especially in terms of its contribution to GDP and value added per worker. Manufacturing in Central Java has a strong textile industry and significant kretek cigarette industry. The balanced development stemmed from the widespread adoption of "green revolution" rice technology, which stimulated increased production and higher farmer's incomes. Well established transport and irrigation networks helped the rice-growing and cash crop sector to respond to a rising demand.

(4) Unequal Level of Economic Development

The contribution of the Wonogiri dam to the development of the Wonogiri irrigated area in Central Java Province is evident. The Wonogiri irrigated area is situated in the eastern part of Central Java Province and is an important area for the increase in rice production (emphasized under the Pelita II-Second Five Year Development Plan). Table 2.1.7 below shows in detail how the Wonogiri reservoir water is distributed to serve the irrigated area.

Table 2.1.7 Present Irrigable Area by Wonogiri Multipurpose Dam

Location	Right main canal (ha)			Left main canal (ha)			Total (ha)
	Gravity	Pumping	Sub-total	Gravity	Pumping	Sub-total	
Wonogiri watershed area	0	0	0	440	250	690	690
Wonogiri irrigated area	20,093	1,700	21,793	6,906	200	7,106	28,899
Total	20,093	1,700	21,793	7,346	450	7,796	29,589

Source: Balai PSDA Bengawan Solo, after Technical Report of Wonogiri Irrigation Project, 2000.

The average yield of paddy in the irrigated area is about 5.5 ton/ha (provincial average of the yield for Central Java is 5.2 tons/ha). There are three (3) crops per year, so called "paddy-paddy-polowijio" and often farmers practice more profitable triple paddy cultivation. The resulting increased incomes from agriculture (thanks to the irrigation) allowed for the development of the industries and services (income levels are discussed

[5] According to BAPPENAS, The Jakarta Post, February 18, 2006

hereunder).

It is also evident that, within Central Java Province, the Wonogiri dam watershed area (not benefiting from the Wonogiri Dam) is lagging behind the Wonogiri irrigated area. Kabupaten Wonogiri is one of the poorest areas in Central Java Province. The low incomes from agriculture and insufficient capital did not allow the creation of the new businesses and expansion of the industries and services, as well as the case of the Wonogiri irrigated area.

The economy of kabupaten Wonogiri still remains heavily dependent on the agriculture, even though the irrigation is scarce. Dry rice field is common. Rice, cassava and maize are the main products. Other crops include coconut, cashew nut and clove in addition to teak, both from the state managed forest and peoples forest.

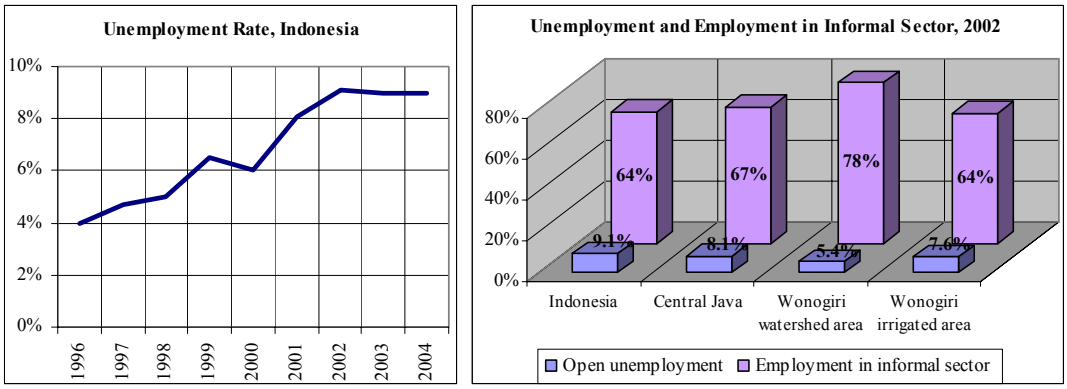
The low incomes from agriculture hindered development of the industries and services. The people needing off-farm incomes have no choice to look for the job opportunities in the larger cities. The seasonal variety, so called boro, is widely cultivated, especially in case the difficult event such as draught takes places. Those are especially young people who leave, and so the labor-intensive works preventing soil erosion are difficult to implement. The tough economic condition is causing illegal logging.

The social survey carried out in this Study confirmed a number of problems related to the livelihoods of the Wonogiri watershed inhabitants; (i) soil erosion/ degradation, (ii) diminishing forest, (iii) decreasing springs and groundwater, (iv) low income from and low profitability of agriculture production, (v) insufficient capital for new businesses and others.

2.1.6 Employment

Many Indonesians are out of work and the unemployment is a serious national problem. Finding work of any kind (well paid or not) has become more difficult. In the past, the unemployment was never more than 5%: open unemployment which was 4.7% in 1997 was 8.1% in 2001 and 9.1% in 2002. It is estimated that another 30% of the workforce is underemployed. These figures are increasing steadily as about 2 million young Indonesians enter the job market every year. The Indonesia's youth are in the worse position. For people aged 15 to 24, the unemployment is around 24% (22% for males and 28% for females).

In comparison with the levels of unemployment between the regions, the unemployment in 2000 was 9.1% for the whole Indonesia, which was larger than 8.1% for the Central Java Province, 7.6% for the Wonogiri irrigated area and 5.4% for the Wonogiri watershed area. The reason why the Wonogiri dam watershed area is at the lowest level of unemployment is that most of the people are involved in the agriculture (65% in 2003). Even though the industrial employment has grown, the bulk of the watershed area residents still work in the agricultural sector under the condition of small- to medium-sized land holdings. Besides, there is a substantial level of employees involved in the informal sector as shown in Figure 2.1.3 below.



Source: BPS; HDI 2004; National Labor Force Survey (SAKERNAS); Laborers/ Employees Situation in Indonesia 2004.

Figure 2.1.3 Unemployment and Employment in Informal Sector

Unemployment is still one of the main socioeconomic problems in the Wonogiri dam watershed area. According to BAPPEDA Wonogiri, the number of unemployed people in kabupaten Wonogiri is increasing every year and there were 14,345 unemployed in 1997 and 57,380 in 2000. The lack of employment opportunities in kabupaten Wonogiri is the cause of the extensive out-migration from the area.

2.1.7 Income and Expenditure

(1) Income

In 1978, farmers in the Project area used to get their income mainly from farming, particularly from paddy production, partly supplemented by the sale of polowijo crops. Income from livestock was very limited. The total annual farm income was estimated at Rp.106,000 to Rp.149,000 for the average farm holding of 0.52ha. In addition, farmers used to get off-farm income such as Sewa (lending land), off-farm labor, trade and others which accounted for 10-20% of average gross income.

At present, the people living in Wonogiri irrigated area are better off than the Wonogiri dam watershed area people.

In the Wonogiri irrigated area, the farm household income is derived from several sources, i.e. food crop, perennial crop, livestock, and off-farm jobs. Food crop income has a direct relation to irrigation and is considered to constitute the biggest part of the total household income. In 2002, the gross annual farm income in the Wonogiri irrigated area was Rp.3.0 million to 14.8 million, with an average of Rp.7.6 million.[6]

For the Wonogiri dam watershed area, the gross annual farm income in 2003 was estimated at about Rp.5 million, including about Rp.2.2 million from on-farm activities.[7] Hence, it can be said that the off-farm activities cover an important part of the total income.

[6] Based on the interview survey with the 282 farmers from the 10 villages located in the downstream area irrigated by the Wonogiri Dam, for the Technical Report on Wonogiri Irrigation Project, 2000

[7] According to the results of household income survey on household income and expenditures, 238 samples; the Department of Environment, Forestry and Mining carried out the household survey in 2003 under the National Movement for Forest and Land Rehabilitation Program (Gerhan)

Table 2.1.8 Annual Farm Income in Wonogiri Watershed Area in 2003

Income Source	Amount (Rp. 000)	Proportion (%)
From agriculture (Paddy, Dry farming and Other)	2,198	42%
Off-farm	3,044	58%
Total income	5,242	100%

Source: Laporan Inventarisasi Kondisi Sosekbud Masyarakat, 2003

However, because of the limited job opportunities in kabupaten Wonogiri, the off-farm income comes mainly from the remittances from the family members working in the urban areas. Due to increase in the number of young farmers, they are forced to look for additional jobs locally or out of the Wonogiri area (including Jakarta, or abroad). Remittances are significant to the local economy. BAPPEDA Wonogiri informs that in 2004 there were about 200-300 thousand migrant workers and it is estimated that each could bring home about Rp.500,000 a year.

The non-agriculture wage levels in Indonesia and in the Project area are shown in Table 2.1.9 below. The regional minimum wage in kabupaten Wonogiri was Rp.314,500 per month in 2002 and Rp.406,000 per month in 2005.

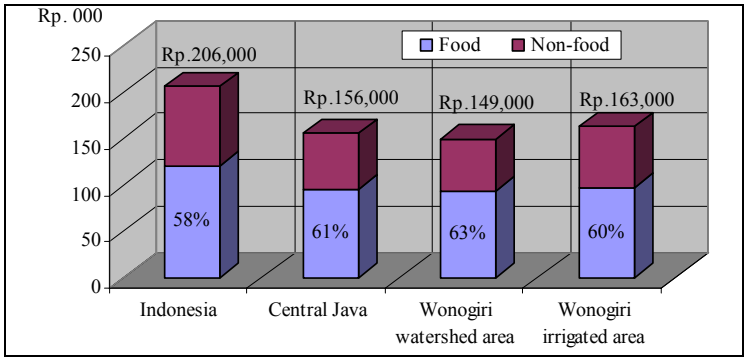
Table 2.1.9 Average Non-Agriculture Wage and Regional Minimum Wage [Rp.000]

Location	Average Non-Agriculture Wage (Rp. 000)		Regional Minimum Wage (Rp. 000)	
	Female	Male	2002	2005
Indonesia	461.8	680.7		
Central Java Province	313.1	500.0		
Wonogiri watershed area:	336.0	484.3	314.5	406.0
Wonogiri irrigated area:	1260.8	2028.8	1290.5	1653.0

Source: Susenas 2002 (National Socioeconomic Survey 2002); BPS 2004

(2) Expenditure

Regarding the expenditure level presented in Figure 2.1.4 below, the monthly average expenditure per capita in Indonesia in 2002 was about Rp.206,000. In Central Java Province, the expenditure level was lower at Rp.156,000, while that in the Wonogiri watershed area is slightly below the provincial average.



Source: Susenas 2002 (National Socioeconomic Survey 2002); BPS 2004

Figure 2.1.4 Monthly Average Expenditure per capita, % of Food Expenditure, 2002

The expenditure for food accounted for 61% of the total expenditure in 2002 in Central Java Province.

2.1.8 Poverty

Between 1965 and 1996, the proportion of Indonesians falling in poverty level decreased

from 60% to 16%. During the crisis, the poverty ratio increased sharply and in 2004 the poverty ratio has fallen back to the 1996 level.

The Government plans to decrease the poverty ratio from 16.6% in 2004 to 8.2% in 2009 (PROPENAS 2005-2009). In general, the income of the poor has been higher in the rural areas than in the urban areas. Most of the poverty reduction since 1999 is the result of change in relative prices, particularly a fall in the price of rice (rice accounts for around 60% of the expenditure of poor households). The second factor is a series of increases in the minimum wage (though this tends to benefit workers in the formal sector and is thought to affect only around one-fifth of the poor). The situation of the poverty in 2002 is shown in Table 2.1.10 below:

Table 2.1.10 Situation of Poverty in 2002

Location	Poverty Line (000Rp./capita/month)	Poor People (000 people])	Poverty Rate (%)	HPI
Indonesia	109.0	38,384	18.2	22.7
Central Java Province	106.4	7,308	23.1	21.0
Wonogiri watershed area:	102.9	246	25.2	20.9
Wonogiri irrigated area:	420.0	802.0	83.6	80.9

Source: BPS and HDI, 2004

In the Wonogiri watershed area in 2002, the people who had a desperate income of less than Rp.102,900 per month were considered poor. There were over 246 thousand poor people in the Wonogiri dam watershed area that is equivalent to about 25% of the total population.

However, judging by the HPI (Human Poverty Index) which represents life expectancy, access to education and access to basic services for the habitants of the Wonogiri watershed are in a relatively better situation as compared with the average levels for the whole Indonesia and Central Java Province. This might be due to that the poverty line in the Wonogiri irrigation area becomes somehow four times higher compared to the poverty line in the Wonogiri dam watershed area.

The Government takes a number of actions to reduce poverty. In 2004, it spent 63 trillion Rupiah (3-5% of GDP) for fuel subsidies alone. These take a form of a reduction in the retail price of kerosene and petrol. As compared with the amount, the entire development budget is only 68 trillion Rupiah.

2.2 Topography and Geology

2.2.1 Topography

The Bengawan Solo River originates on southwest slope of G. Rahtawu in Tertiary Volcanic mountainous area and flows westward along the series of mountains. The Solo River generally takes a northward direction, receiving the Alang River, Temon River, Tirtomoyo River and Keduang River immediately upstream of the Wonogiri Dam. Downstream of the Wonogiri Dam, the Solo River flows clockwise around Mt. Lawu and flows eastward to Ngawi City after running through the alluvial plains of Surakarta City and Sragen City. After the confluence with the Madiun River, the Solo River flows northward to Cepu City before changing direction to the east-northeast and pouring into the Jawa Sea, about 30 km to the northwest of Surabaya City.

2.2.2 Regional Geology

The Study Area is located in the southwestern foothill of Mt. Lawu and situated around the boundary between the Solo Zone and Southern Mountains Zone. These geomorphic zones of Java form belts extending in an east to west direction that extends further eastwards to Bali Island.

The Wonogiri dam and reservoir area is underlain by volcanic breccia, tuff breccia, tuffaceous sandstone, calcareous sand and limestone of Miocene age belonging to the Southern Mountains Zone. Quaternary volcanic products of Solo Zone are distributed on the right bank of the Wonogiri Dam and the Keduang River.

2.3 Meteorology and Hydrology

2.3.1 Basin Rainfall

The rainfall data on the Study Area are available from a number of sources. Of them, the primary one is the Irrigation Services and the other sources are PBS and BMG offices which operate rainfall monitoring stations in the Study Area. Based on availability and reliability of the rainfall data in and around the Wonogiri Dam catchment, 36 rainfall stations are selected to analyze the rainfall condition of the Study Area. As shown in Figure 2.3.1 (see next page), an isohyetal map of mean annual rainfall over the Wonogiri catchment is worked out based on the rainfall data at the selected 36 stations for the period from 1983 to 2005. Further, the basin average rainfall for each tributary is estimated by means of the arithmetic mean method. Table 2.3.1 below shows the estimated mean monthly basin rainfall for the five (5) major tributaries. The Table shows that annual rainfalls in the two (2) tributary basins, the Keduang and Tirtomoyo River basins, are considerably higher than those in other three (3) major tributary basins.

Table 2.3.1 Mean Monthly Basin Rainfall by Major Tributary in the Wonogiri Dam Catchment (1976-2005)

(Unit : mm)

Tributary Basin	Month												Annual
	J	F	M	A	M	J	J	A	S	O	N	D	
Keduang	393	353	326	215	90	62	32	22	30	104	236	287	2,148
Tirtomoyo	394	374	340	229	90	72	32	13	22	72	205	282	2,124
Temon	339	326	289	181	75	57	21	10	14	61	160	274	1,807
Bengawan Solo	340	317	276	170	84	61	22	12	19	58	155	243	1,757
Alang	326	289	256	154	66	61	24	10	18	51	159	237	1,671
Remaining Area	341	315	283	181	85	61	32	15	17	77	167	236	1,812
Whole Catchment	369	336	307	201	89	64	31	16	24	82	198	274	1,990

Source: JICA Study Team

2.3.2 Inflow into the Wonogiri Reservoir

(1) River Discharge Data of Major Tributaries

The hourly discharge data on major tributaries are required to carry out the simulation for the reservoir sedimentation analysis, because sediment inflow volume is highly dependent on the magnitude of peak discharge of floods. Although water level records in chart at only 3 stations could be obtained in the field investigation, the available data periods at these three (3) stations are very limited. Taking into consideration the available periods and accuracy of the past hydrological data observed at streamflow gauging stations on the

major tributaries, it is judged that it is too hard to estimate the inflow to reservoir from each tributary based thereon. Hence, it is determined that at first the long-term total daily inflows to the reservoir are estimated based on the reservoir operating records of the Wonogiri dam and that they are distributed to each tributary based on the observed tributary flow during this Study and through the rainfall-runoff simulation for the past period to estimate the reservoir inflow from each tributary. Consequently, the daily total reservoir inflow volume is distributed to the five (5) major tributaries and remaining area on a hourly data basis by using the observed discharges for the period from November 2004 to June 2005 and simulated discharges for the period from November 1993 to October 2004.

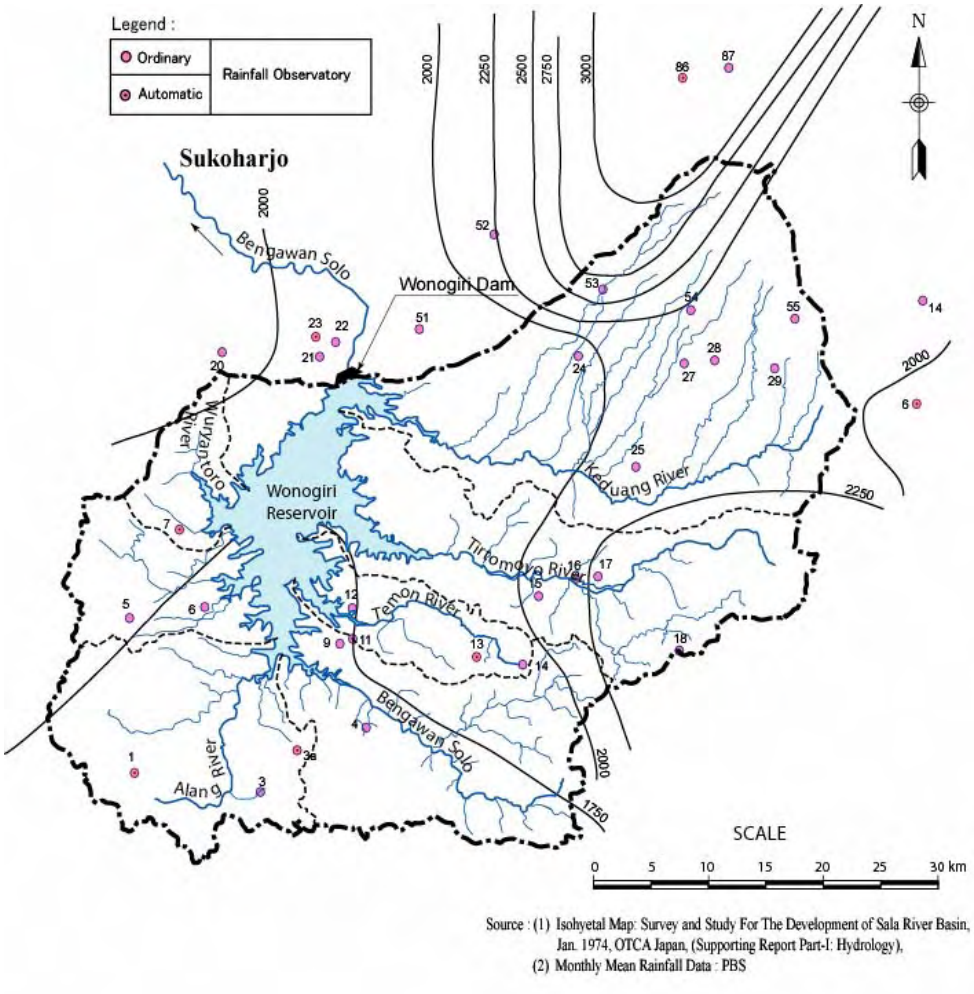


Figure 2.3.1 Isohyetal Map of Annual Rainfall for the Wonogiri Dam Catchment

(2) Long-Term Inflow into Reservoir

The reservoir operation of the Wonogiri dam has been recorded since 1983. The daily operation records comprising the reservoir water level and outflow from turbine, spillway and hollow-jet valve are available completely for the period from 1983 to 2005. The hourly records have been recorded by the office of the hydropower station (PLTA Wonogiri), but the complete records for the period from 1983 to 1994 are not available. The estimated long-term reservoir inflow is discussed in succeeding Section 3.1.

(3) Large Flood Inflows into the Wonogiri Reservoir

The inflow hydrographs of large flood into the reservoir are derived based the hourly

reservoir operation records for 1983-2005. The estimated large floods are presented in Table 2.3.2 below:

Table 2.3.2 Estimated Large Floods into the Wonogiri Reservoir

Year	Occurrence Date	Peak Discharge (m^3/s)	Inflow Volume (million m^3)
1983	April 14 to 18	2,660	80.8
1984	January 4 to 5	1,650	52.3
1985	March 6 to 9	2,720	223.0
1988	February 4 to 6	2,880	130.3
1991	February 9 to 12	1,210	94.0
1992	February 12 to 15	1,210	109.6
1994	March 7 to 10	1,760	106.1
1998	December 22 to 26	1,350	37.2
2000	February 3 to 7	1,600	26.1
2003	January 2 to 5	1,010	104.9
2004	December 3 to 4	1,330	32.0

Source: JICA Study Team

As seen in the table above, the Wonogiri reservoir experienced inflow of large-scale floods with peak discharges exceeding 2,000 m^3/s. One such large-scale flood occurred immediately after completion in 1980 and the largest flood peak discharge is recorded at 2,880 m^3/s on February 5, 1988, followed by the 1985 flood of 2,720 m^3/s.

(4) Estimated Reservoir Inflow from Five (5) Major Tributaries and Remaining Catchment

Hourly reservoir inflows from five major tributaries in 1993-2005 were estimated based on the reservoir operation records. Hourly discharge records at major tributaries that were observed under the Study were available only the wet season from November 2004 to May 2005. In other period for 1993-2004, simulated hourly discharges as well as hourly reservoir operation records were used. The table below shows the estimated mean monthly inflows from major tributaries on the hydrological year basis in 1993-2005.

Table 2.3.3 Estimated Mean Monthly Dam Inflow from 5 Major Tributaries and Remnant Area (Nov. 1993 – Jun. 2005)

(Unit : 10^6 m^3)

Tributary Basin	N	D	J	F	M	A	M	J	J	A	S	O	Annual
Keduang	22.9	38.7	50.0	81.1	82.6	44.6	10.7	7.5	5.0	2.2	3.2	5.9	354.3
Tirtomoyo	11.6	26.7	29.9	49.0	48.5	26.9	6.3	4.4	3.4	0.6	0.3	2.8	210.4
Temon	2.2	5.0	6.7	10.3	9.7	5.1	1.1	0.8	0.5	0.0	0.1	0.5	41.9
Bengawan Solo	8.1	17.7	22.2	36.0	34.9	16.4	3.8	3.0	2.0	0.2	0.3	1.8	146.4
Alang	7.8	15.2	18.7	27.4	30.0	12.3	3.0	2.4	1.0	0.1	0.2	1.7	119.8
Remaining Area	7.0	13.6	16.5	25.5	25.0	13.7	3.5	2.5	1.7	0.4	0.6	1.8	111.7
Whole Catchment	59.6	116.9	144.1	229.3	230.6	119.0	28.3	20.5	13.6	3.6	4.7	14.3	984.4

Source: JICA Study Team

2.4 Soils and Land Use

2.4.1 Soils

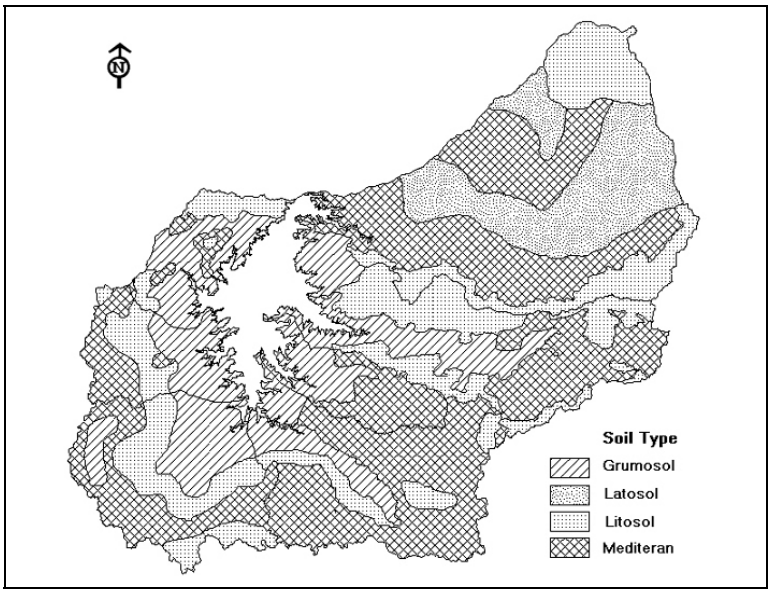
The present soil study has been made based on the soil maps (scale: 1/25,000) prepared by SBRLKT, Solo in 1985, the reconnaissance map (1/250,000) prepared by the Soil Research Institute, Bogor in 1973, an existing document[8] and field reconnaissance survey. The SBRLKT's maps were prepared on the basis 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 dam 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 2.4.1. The distribution of the soils in the Wonogiri watershed are shown in Table 2.4.1 and summarized below.

Table 2.4.2 Soil Distribution in Wonogiri Dam 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: JICA Study Team



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

Figure 2.4.1 Soil Map of Wonogiri Dam watershed

2.4.2 Land Use

(1) Methodology

The survey was conducted by using the land use map (1/25,000) prepared by

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

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 BPDAS 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 dam 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, upland field occupies the largest share followed by paddy 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 & plantation) is rather limited in the Wonogiri dam watershed. The present land use of the Wonogiri dam watershed is shown in Figure 2.4.2 and summarized below.

Table 2.4.3 Present Land Use in Wonogiri Dam 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*
- Settlement area under upland field condition	*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 (areas covered with young trees reforested and upland crops in State forest)	*12,394*	*10.0*
(7) Others (lakes, roads, rivers and other use)	1,384	1.1
Total	**124,331**	**100.0**

Source: Results of JICA field survey and interpretation of Satellite image (2003), and data of BAKOSURTANAL

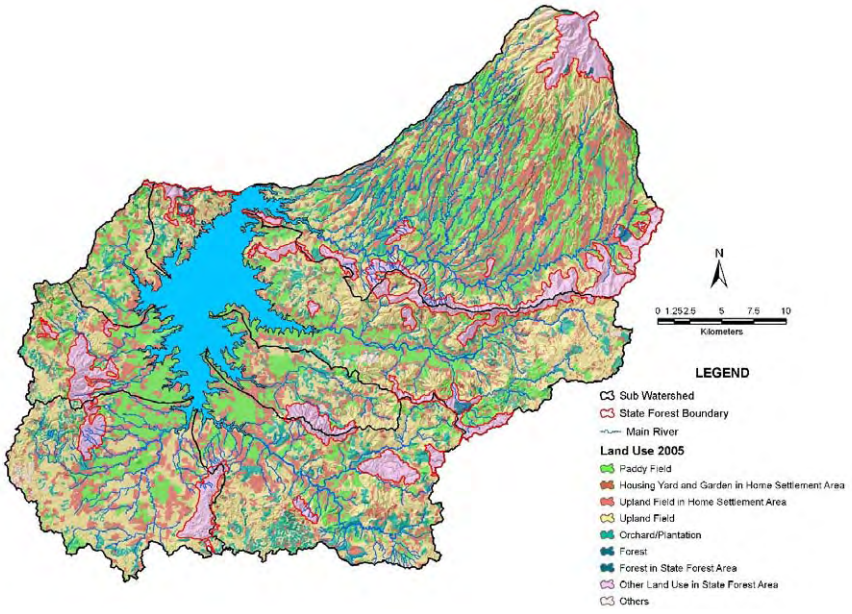


Figure 2.4.2 Land Use Map in the Wonogiri Dam Watershed

2.4.3 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 2.4.4 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
Non-terrace (N)	N	-	-
Composite (M)[1/]	M	-	-

Note: 1/ ; Land of composite condition of ridge terrace and non-terrace
Source: JICA Study Team

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 2.4.5 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)	-

Source: JICA Study Team

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 dam watershed is illustrated in Figure 2.4.3 and summarized below.

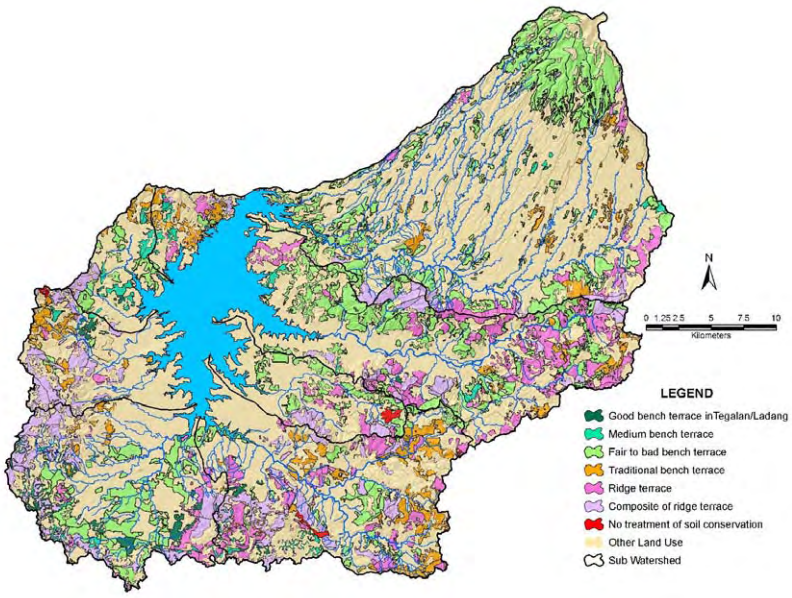


Figure 2.4.3 Terrace Condition in Upstream Field in Wonogiri Dam Watershed

Table 2.4.6 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 2.4.7 Criteria for Classification of Bench & 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 2.4.8 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 dam watershed. The typical terraces are shown in the following photos:

Well maintained terrace with grass riser

Maintained terrace

No maintained terrace

Poorly maintained terrace

2.5 Agriculture

2.5.1 General

The agriculture sector is the largest economic sector in Kabupaten Wonogiri and 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)

2.5.2 Crop Sub-Sector

(1) Overall Features

Crop sub-sector's activities in the Wonogiri dam watershed are characterized by food crops production in paddy field (wet land farming) and food, horticulture and estate crops production in dry land (dry land farming). The wet land farming is practiced in paddy fields extending in low-lying areas and in rice terraces constructed on sloping land. The dry land farming is extensively practiced in terraced fields constructed on moderate to steep sloping land. The primary crop in the wet land farming 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)[9] 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[10].

(3) Dry Land Farming

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 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

[9] Kecamatans belonging to Kabupaten Wonogiri located in the Wonogiri watershed
[10] Wonogiri in Figures, 2003, BPS Wonogiri

exposed to danger of water erosion if sufficient vegetative covers are not provided.

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 2.5.1 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

Source: JICA Study Team

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 dam 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. Based on the survey 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 2.5.1.

2.5.3 Livestock & 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 summarized below.

Table 2.5.2 Changes in Animal and Fowl Population in Project Kecamatans

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: The number of livestock is rounded figures.
Source: Wonogiri in Figures, 1983 and 2003, BPS

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 dam 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 2.5.3 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

2.6 Forestry and Watershed Management

The forest areas in the Wonogiri watershed 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 people's forest is under the control of individual land owners. In the peoples forest, community based forestry development activities are promoted by forestry agencies.

2.6.1 Current Statuses of State Forest

The state forest in Java Island is under the jurisdiction of State Forest Company of the Ministry of Forestry 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). The Wonogiri dam watershed is mostly under the control of 4 BKPHs[11] and 17 RPHs as follows:

Table 2.6.1 BKPH Related to Wonogiri Dam 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 dam watershed, classified by the KPH, are summarized below:

Table 2.6.2 Current Status of State Forest Related to Wonogiri Dam Watershed in 2004

(Unit: ha and %)

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

Remarks: *; Includes unsuitable area and others. Source: Perum Purhutani KPH, Surakarta

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

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

resources conservation, flood protection, erosion control and mitigation of sedimentation in lower reaches. The forests in the Wonogiri dam watershed are mostly of natural forests and partly afforestated areas. The areas designated as the forests in the Wonogiri dam 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. 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.

2.6.2 Current Statuses of People's Forest (Hutan Rakyat)

The people's forests (*hutan rakyat*) are defined as forest areas owned and operated by individuals (villagers/farmers)[12]. The extent of the forests in the project kecematans in the Wonogiri dam 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. The people's 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 people's 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.

2.6.3 Current Statuses of Community Based Forestry Conservation Development

The community based forestry development activities are implemented in the Wonogiri

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

dam 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 People's 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 & Land Rehabilitation)

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

1) Objectives and Scopes

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 Forestry under the support of three (3) Coordination Ministers of Welfare, Economy and Policy & 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

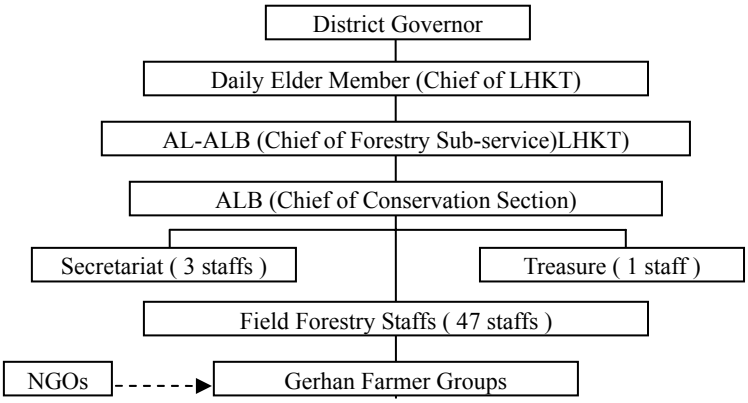
In the Wonogiri dam watershed, the GERHAN activities are implemented from 2003. The programs executed in the area include fiver (5) programs. All the programs in 2003 and 2004 have been executed as planned in the previous years. The programs and volumes implemented in 2003 and 2004 are shown below:

Table 2.6.3 GERHAN Implemented and Planned in Wonogiri Dam Watershed

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

Source: GERHAN Programs in 2003 and 2004

The 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 BPDAS, Solo. The organization setup for the implementation is illustrated below:



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

Figure 2.6.1 Project Organization for GERHAN in Kabupaten Wonogiri

(2) Conservation Activities by Other Agencies

BPDAS Solo as a technical implementation unit of Directorate General of Land Rehabilitation and Social Forestry has some allocation of budget for conservation activities. The primary activity in 2004 was "seedling production (procurement) for GERHAN".

2.6.4 Assessment to IBRD Project (Upper Solo Watershed Protection Project) in Wonogiri Dam 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: i) control and prevention of soil erosion and sedimentation into the Wonogiri Dam, ii) rising of living standard of the farmers in the basin through improvement of agricultural productivity and incomes, iii) dissemination of conservation practices that farmers can carry out them with self-reliance, and iv) 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 2.6.4 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**

Source: BCEOM evaluation report in 1991

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 BPDAS 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 2.6.5 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: Bceom evaluation report

In 1991/92, 50% of the gabion gully plugs requires a lot of maintenance due to improper site selection and improper design. 65% 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 2.6.6 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: Bceom 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 i) construction of boundary pole, project signboard, field house and data board, ii) procurement of one hand sprayer, iii) provision of farm input including grass for terrace riser, and iv) 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 2.6.7 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	$2.3m^3$

Source: Bceom evaluation report

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.


Orchard trees on bench terrace

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 dam 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 i) Mahogany, ii) Accasia auriculiformis, iii) Eucalyptusalba, iv) 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:

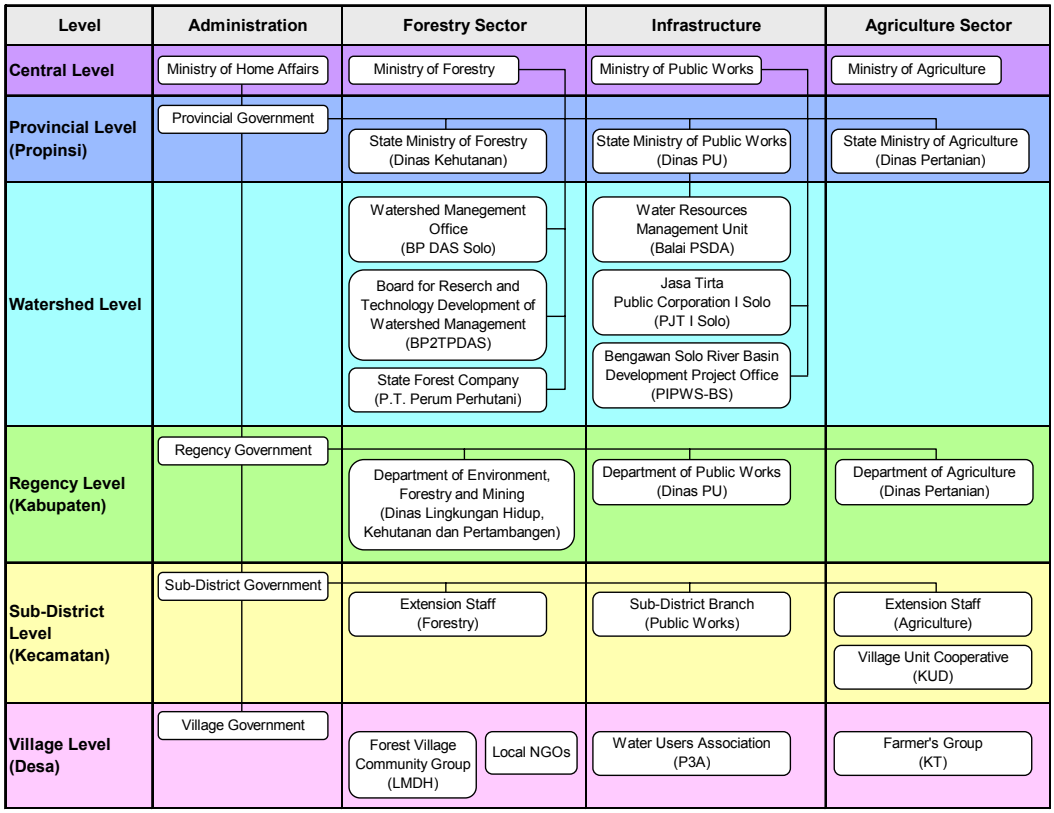
All the project costs are subsidized by the Government. The farmers who participated in the project have no responsibility of voluntary labor contribution for the project construction and provision of some materials necessary for the project. Concerning labor force required for the project, the participated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

2.7 Organizational Framework for Watershed Management

Various organizations are involved for the conservation and management of the Wonogiri dam watershed. They are divided into three levels of organization in two principal sectors, forestry and agriculture:

a) Local government agencies,
b) Provincial and other regional government agencies,
c) Central government agencies,

The present organizational framework for watershed conservation is shown in the figure below:



Note: In addition to the above organizations, PLN, PDAM etc. are involved.
Source: JICA Study Team

Figure 2.7.1 Present Organizational Framework for Watershed Conservation

Current institutional conditions and issues of each organization above have been studied and summarized in Annex No.11: Institutional Study for Watershed management in the separate volume.