THE APPLICATION OF SUSTAINABILITY CONCEPT IN WATERSHED MANAGEMENT

(Case Study: Serayu Watershed, Central Java, Indonesia)

THESIS

A thesis submitted in partial fulfillment of the requirements for
the Master Degree from the Institut Teknologi Bandung and
the Master Degree from the University of Groningen

by:

YONKY INDRAJAYA
ITB : 25404048
RUG : S 1578367

DOUBLE MASTER DEGREE PROGRAMME

DEVELOPMENT PLANNING AND INFRASTRUCTURE MANAGEMENT
DEPARTMENT OF REGIONAL AND CITY PLANNING
INSTITUT TEKNOLOGI BANDUNG

AND

ENVIRONMENTAL AND INFRASTRUCTURE PLANNING
FACULTY OF SPATIAL SCIENCES
UNIVERSITY OF GRONINGEN

2006

THE APPLICATION OF SUSTAINABILITY CONCEPT IN WATERSHED MANAGEMENT

(Case Study: Serayu Watershed, Central Java, Indonesia)

by

YONKY INDRAJAYA
ITB : 25404048
RUG : S 1578367

Double Master Degree Programme

Development Planning and Infrastructure Management
Department of Regional and City Planning
Institut Teknologi Bandung

and

Environmental and Infrastructure Planning
Faculty of Spatial Sciences
University of Groningen

Approved

Supervisors
Date: August, 2006

Supervisor I	Supervisor II
(Dr. Johan Woltjer)	(Dr. Roos Akbar)

ABSTRACT

THE APPLICATION OF SUSTAINABILITY CONCEPT IN WATERSHED MANAGEMENT

(Case Study: Serayu Watershed, Central Java, Indonesia)

*This research is about applying both sustainability concept and watershed management concept in a certain area. Sustainability as a fuzzy concept is translated into indicators as a tool for assessment. Watershed management is a buzz word in managing the water recently, which integrates not only policies, programs, and projects vertically, but also horizontally. This research uses the combination method the case study and literature study method. The literature study develops appropriate indicators for assessment, while case study provides variable to be analyzed. The research found that the criteria for assessing sustainable watershed management are: environment, social, economic and institutional. The indicators selected are: budget allocation on environment, agricultural and forest area, water quantity and quality (**environment**); poverty level, education level, and population growth (**social**); GDP per capita, economic structure, and economic growth (**economic**); and existence of national strategy on sustainable development, clear job division from all stakeholders, and the agreement among stakeholders (**institutional**). In general, Serayu watershed management plan has not fully fulfilled sustainability concept based on the indicators defined. But, there are strong efforts toward it.*

Keywords: *sustainability, watershed, management, criteria & indicators, Serayu*

PREFACE

Water, as a resource is essential for living things and need an appropriate management approach. In the past, water is managed sectorally without considering other aspects. Nowadays, the new perspective of water management combining environment, social, and economic is used. This perspective is in line with sustainable development discourse, which concerns on long term environment, social, and economic stability. The research focuses on the applying both sustainability and watershed management in one specific area.

First of all, I would like to thank to Allah SWT for blessing me with the health and opportunity to continue my study in ITB and RUG. Without his blessing, it is impossible to do everything.

I would like to thank to my supervisors Mr. Johan Woltjer from University of Groningen (RUG) and Mr. Roos Akbar from Institute of Technology Bandung (ITB) for your kindness, patience, challenging comments, and intensive discussion during the process of my thesis writing. I also would like to thank to the Dean Mr Gerald Linden and the course manager Mr Paul Ike for their help during the study.

In addition, I would like to express my fully appreciation for the Indonesian National Planning Board (Bappenas) and the Netherlands Education Center (NEC) for giving me the opportunity continuing my study in ITB and RUG.

Also, I would like to thank to all my colleagues in Faculty of Geography and Faculty of Forestry in Gadjah Mada University Yogyakarta and my office Watershed Management Technology Center Surakarta for your help in supporting the materials for this thesis.

Special thanks for my lovely wife Ratna and my lovely daughter Zahra for your love, hope, patience, and support during my study in Groningen.

Finally, I would like to thank to all my friends in double degree program ITB-RUG 04 for the nice experiences in the last two years.

Table of Contents

List of Tables

List of Figures

Chapter 1 Introduction

This chapter elaborates the research design consisting of background, objectives, research questions, methodology and structure. The background describes this research in the academic discourses, why sustainability concept and watershed management are important is elaborated. The background also depicts the current condition in Indonesia and identifies some gaps in the previous researches. The objectives highlight the purpose of the study, research questions and scope of this study. Methodology depicts how this research will be conducted illustrating in the flow of research. The structure explains the emphases of each chapter in this research.

1.1 Background

Current discourse

One of the prerequisite of development is the use of resources to achieve good quality of life of human being. Good quality of human being sometimes defines as the achievements on economic perspective while the use of resources as the environmental perspective. It is impossible to separate economic development issues from environmental issues because many forms of development erode environmental resources which they must be based, and environmental degradation can undermine economic development (WCED, 1987). There are some consequences regarding this issue, such as: the limitation of usage on unsustainable input of production, giving more concern on the future generation, and promote sustainable society.

Water, as one of the resources, which is essential for living thing, needs an appropriate water management approach. Tyson (2000) noticed that there is a developing concern of the world on the inadequateness of water resources demanded by humankind. Moreover, due to the growing population, the demands for resources such as forest, water and wildlife are also increasing. In the past, the utilization management of these resources is independent and not related one to another. The management is not integrated and lack of concern about the interrelationship among sectors. This management has caused the dispute of the people concerning the needs of the resources in the future (Naiman, 1992). Water management also used this perspective in the past which only focuses on the water issue without integrating all aspects such as social, economic and environment.

As a consequence, water management approach needs a new perspective that combine social, economic and environmental concerns with an approach to watershed management where forest, agriculture, urban, and other land use are treated in integrated manner. The management would be integrated horizontally, which concerns the policies made among the similar level of authority, and vertically, which gives attention on policies made from sequence level of authority . Moreover, watershed management has become consensus in the world as an approach in water management. The new perspective is to balance long term ecological, economic, and social stability with cumulative environmental change. Hence, the economic strength

will focus on the watershed scale through efficiently using natural resources and maintaining the environment quality (Naiman, 1992).

The historical development of the concept of sustainable development from 1962 until the present was reviewed in the workshop of reassessment of sustainability on water sector held in Alexandrina in 2003. The workshop underpins the non successful experiences in applying sustainability concept in some developing countries due to the lack of commitment from administrations to implement it.

> *"Non-successful 'experiments' with water management in developing countries and questionable leadership were some of the specific examples that were considered, and which indicated a lack of commitment from several administrations, many of which have given strong lip service to sustainable development, but do not seem to be in any hurry in implementing it".* (Serbulea and Tortajada, 2003, p104)

Workshop also indicates that international organizations are also responsible for this slow motion, since, in many cases, they pretend not to notice the lack of actions in many developed and developing countries. Regarding the non-governmental organizations, their performances, attitudes and impacts need more serious and objective scrutiny than has been given so far (Ibid). Watershed management initiatives face numerous obstacles, more social than hydrological and needs the degree of political commitment to the objectives by those who have authority (Kraft et al, 1990, p 10) in Blomquist and Schlager (2004). Koontz (2005) argues that a key component of sustainability and sustainable development is citizen empowerment in decision shaping social and environmental conditions. Koontz (2005) also noticed that one strategy to promote citizen participation and empowerment is the decentralization, or transfer of authority, from central governments to local governments or community organizations.

Recently, the trend towards more regional management and planning in water is applied in some countries. Over the past twenty years, a strong global consensus has begun to develop around the notion that the watershed is, in fact, the best unit for the management of water resources (Heathcote, 1998). Indonesia has also applied the watershed approach in water resources management, which is also well known in Indonesia as "one river, one plan and one management"(Bandaragoda, 2000).

The recent international agreement on water resources management is stated in the World Summit on Sustainable Development (WSSD) held in Johannesburg. Rahaman and Varis (2005) noticed that based on WSSD in water issue, Integrated Water Resource Management (IWRM) is one way in managing water resource with "sustainability" concept. IWRM should be applied in basin context together with principles of good governance and public participation. Thus, an integrated watershed management approach is essential for land and water use planning due to the complexity of land/water interactions (Tyson, 2000).

> *IWRM is based on the perception of water as an integral part of ecosystem, a natural resource and a social and economic good, whose quantity and quality determines the nature utilization. To this end, water resources have to be protected, taking into account the functioning of aquatic ecosystems and the perenniality of the resource, in order to satisfy and reconcile needs for water in human activities.* (Allouche and Finger, 2001, p 42)

Case of Indonesia

As one of the United Nations (UN) members, Indonesia has ratified global consensus on environmental issues, such as "sustainable development", "Agenda 21", "Kyoto Protocol", "Integrated Water Resource Management (IWRM)", etc. that has implications for Indonesia. Issue related to water has stipulated in "water act" in 2004 as an initiative towards sustainable water resource management. This water act also indicates water resource management in watershed level. Moreover, Indonesia has also applied decentralization concept in the government by the act of decentralization in 1999 which is also assumed to one way of getting more public support in development programs including water management programs or plans.

Even though some global consensus on environmental issues have ratified by the government of Indonesia, the environmental problems particularly water still occur in Indonesia. Flood, drought, erosion and sedimentation, and pollution together with social and economic problems still emerge.

Watershed management indicates the cooperation and coordination between administrative areas within the watershed area. The cooperation between upstream and downstream as mandated by the watershed management concept will ensure the minimum environmental externalities. For example, in Serayu watershed the introduction of water and soil conservation technology in Wonosobo regency which is in upstream will reduce the soil erosion causing the sedimentation problem in Banjarnegara regency which is in downstream. In contrary, the concern of each administrative area within watershed is economic or local revenue as inspired by the decentralization concept.

As will be the case study watershed in this research, Serayu watershed faces the complex problems related to water and have been reported in some media. For example, Kompas daily newspaper in Indonesia on August, 2nd 2002 highlighted the environmental degradation on Serayu watershed in Central Java Province, Indonesia, as a result of the highly deforestation in the upper watershed and the potato agricultural area in the upper which is not considering environmental issue. Erosion level in Merawu tributary and Serayu is 5 – 14 mm/year or 9.6 mm/year in average showing the high erosion there. As comparison, the average erosion level in Serayu watershed is only 4 mm/year. Due to this high sedimentation level, the lifetime of a dam (Panglima Besar Sudirman dam) located in Banjarnegara regency, supplying irrigation water in Serayu watershed and hydropower generator supplying electricity for Java-Bali Island is getting shorter from 50 year projection to 33.5 year.

Other media (Bernas, July 10th 2002) highlighted the water quantity condition in the dry season in Serayu watershed. The river discharge significantly decreased influencing the low quantity of water in the dam disturbing the irrigation water supply to farmers and threatening the hydropower capacity from 180 MV to 30 MV. Suara Pembaruan (August 8th 2003 also reported that the water quantity in Panglima Besar Sudirman dam decreased significantly influencing the drought in paddy field (22.000 ha) causing lower production of rice. In November 5th, 1998, Bernas daily news reported that there was a big flood occurs in downstream of Serayu watershed causing one death and thousands of people evacuated.

Research Problem

Recent researches in sustainable development are focusing on how sustainability concept is applied in planning (de Roo, 2004; Healey, 1999). Many others focus on the development of sustainability indicators appropriate to local area (Rydin et.al, 2003; Foxon, 1999; Eckerberg and Mineur, 2003; Astlethner and Hamedinger, 2003). Hoekstra (1993) has made a scientific framework for the planning of sustainable water resource management, but it doesn't test any case studies. Hence, it is important to develop local indicators for sustainability particularly in Indonesia specifically in watershed context to reduce the environmental problems related to water to ensure the availability of resources for future generation. Institutional and policy analysis in Brantas watershed in Indonesia has been conducted by the World Bank (Bhat et al, 2005). It describes the basin organization in Brantas watershed in line with the decentralization era in Indonesia. Watershed Management Technology Center (WMTC) in 2004 has also conducted the institutional analysis in some watershed in Java related to decentralization era. The philosophical concept such as sustainability was hardly ever been researched in Indonesia, particularly related to water. Thus, it is interesting to discern the application of both concept "sustainability" and "watershed management" in one specific area in Indonesia to give more understanding of the opportunities and challenges to the decision makers.

1.2 Research Objectives

The main objective of this research is to understand how the "sustainability" concept is applied together with "watershed management" concept in one area (case study in Serayu watershed, Central Java, Indonesia). From this main objective, it can be derived into several mid objectives:

- To understand what are criteria and indicators of sustainable watershed management
  This objective is to provide appropriate sustainability criteria and indicators in Serayu watershed based on local conditions. It selects many criteria and indicators developed in the chapter 2 and 3.
- To understand the application of sustainability concept in watershed management in Indonesia
  This objective is to elaborate both sustainability concept and watershed management as import concepts applied in Indonesia by testing the case study master plan.
- To understand the opportunities and challenges of the application both concept "sustainability" and "watershed management"
  This objective is to describe the consequences of the application of both concept "sustainability" and "watershed management" based on the condition of case study.

1.3 Research Questions

From the research problems and background mentioned above, I would like to propose several research questions which can direct the research:

- *What are the criteria and indicators of sustainable water management in theoretical view?*
  This question will be answered in the literature review in chapter 2 and 3. The academic discourse in chapter 2 will elaborate the criteria and indicators of sustainable watershed management. Some criteria and indicators of sustainable development and sustainable watershed management from other counties will also be used as considerations as elaborated in chapter 3.
- *How does government cope with environmental, social, economic and institutional issues in watershed context related to sustainability*?
  This question focuses on the practical aspects of the government of Indonesia in the case study related to environment, social, economic and institutional issues. What opportunities and challenges for the government in dealing with these issues are described.
- *What lessons can be learned from such practices in coping with applying "sustainability" concept in watershed context?*
  This question focuses on the lessons can be learned in previous practice in applying both concept "sustainability" and "watershed management" in one specific area to be better in the future.

1.4 Scope of Study

The study focuses on the application of sustainability concept as defined through theoretical framework made, based on local condition by "testing" the master plan of Serayu Watershed following criteria and indicators defined in the literature review. The study will not elaborate deeply other policies related to the study such as water act, decentralization act and environmental act.

1.5 Methodology

The research will use combination method, case study and literature study method. Case study method will elaborate the characteristics of Serayu Watershed Management to be the variable of analysis. The variable of analysis includes: biophysics, social, economic, and institutional characteristics. The data collected are secondary data, which are available in the research reports, policy documents, and plan. The deep understanding of the case study shall be generalized as lessons that can be learned in other similar cases. Literature study will elaborate and determine the theoretical framework used in assessing the application of the "sustainability" concept in "watershed management". By combining these methods, all variables in the case study can be supported by strong argumentations based on the theoretical framework developed in the literature study. Thus, the results of this research will be more useful as references in similar cases.

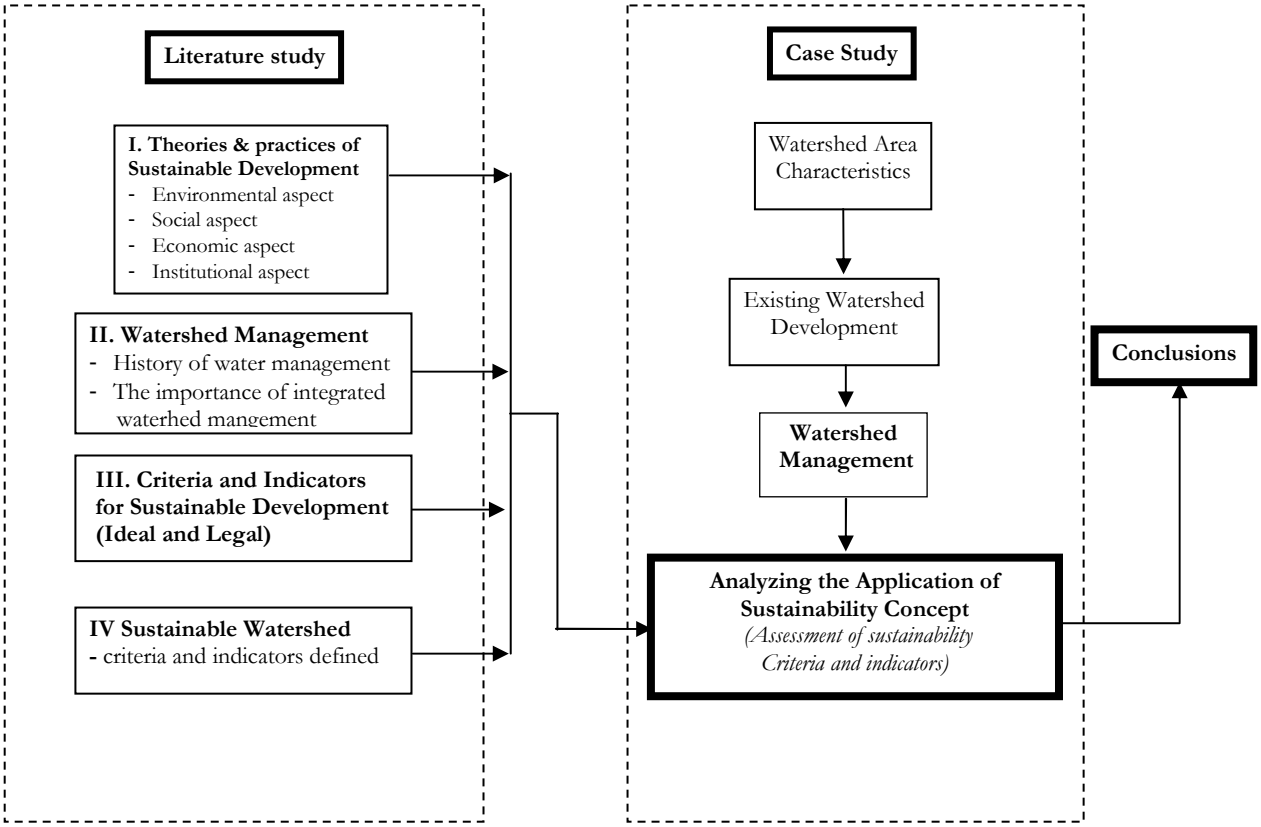

Figure 1.1 Theoretical Framework

1.6 Structure

This research consists of 6 chapters. Chapter 1 describes the background, research objectives, research questions, scope methodology and structure used in the research. The importance of the study is described in this chapter. Chapter 2 elaborates the literature study on sustainable development and watershed management from theoretical point of view. The applications of sustainability concept in watershed management in some countries are also described to draw some lessons. While chapter 3 points out at sustainability assessment used in the chapter 5. The criteria and indicators of sustainable watershed management are developed in this chapter. Chapter 4 illustrates the characteristics of the case study to draw the case study. Chapter 5 elaborates the sustainability assessment in the Serayu watershed using the criteria and indicators developed in Chapter 3. Conclusions are drawn in chapter 6 answering the research questions in Chapter 1. Some recommendations also developed in this last chapter.

Chapter 2 Sustainability and Water Management

This chapter elaborates the concept of sustainability and its manifestation "sustainable development" and their discourses in the world. Some aspects of sustainability and sustainable development such as environmental, social, economic and institutional are also described. This chapter also describes watershed management from its practical and theoretical point of view as an approach in the water resource management recently. Some applications of watershed management in some countries are also illustrated briefly to extract some lessons.

2.1 Sustainability Concept

Discourse on Sustainability Concept and Sustainable Development

Sustainability is an unclear and ambiguous concept (Hoekstra, 1993; de Roo, 2004; Pope *et al*, 2004). De Roo (2004) describes that sustainability concept as fuzzy and fluid concept tend to have in common acceptance by many, and consequently appear regularly in policy documents, but the implementation of this concept is sometimes disappointing. Buckingham-Hatfield and Evans (1996) describes sustainability as "overarching societal value" and it possibly be interpreted differently among societies that in turn there is a big different between rhetoric and reality. The broad acceptance of sustainability makes the planning process logically follow the top down and technical rational approach, while the implementation of doing so leave the room for multiple interpretation (de Roo, 2004).

Hoekstra (1993) in his work divides sustainability literature into two parts: the linguistic and modeling one. The linguistic literature, he argues, only creates cycles of words and sentences, but not providing scientific grip. In contrary, the modeling literature in which quantification plays important role is better one. Even better one, modeling literature also has critiques. For example, the current models of sustainability are not founded in general theories, and the models only describing reality without involving values.

Efforts to make the sustainability concept become clearer and certain have been done by many authors. De Roo (2004) in his book promotes an actor consulting effort in the planning process that can make the fuzzy become clearer and certain through achieving the consensus among actors about their interests and goals at the advance stage of development. Sustainability can be translated into programs and projects based on the social agreement.

Hoekstra (1993) divides sustainability concept based on the interest into three: individual (interest on human being), social (interest on man as a species) and ecology (interest of life). Then, he also distinguishes three types of sustainability: individual, social, and ecological sustainability. Spangenbarg (2004) adds the forth dimension of sustainability as institutional sustainability in which the rules made by social agreement is the focus.

Lee (1992) sees that sustainability concept as stated by Brundtland Commission report (1987) as "*meets the needs of the present without compromising the ability of future generations to meet their own needs*" has consequences on human activities that

address the limitations imposed by the present state of *technology* and *social organization* on environmental resources and by the *ability of biosphere* to absorb the effects of human activities

Martens (2006) describes the essence of sustainable development is *"to provide for the fundamental needs of humankind without doing violence to the natural system of life on earth"*. Bossel (1999) redefines sustainable development as "*economic development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs"*, while others define sustainable development in broader perspective as: "*the kind of human activity that nourishes and perpetuates the historical fulfillment of the whole community of life on earth"*.

There are four goals of sustainable development which is reflected the struggle of world population occurred regularly in the 20th century: peace, freedom, better living conditions, and a healthy environment (NRC, 1999) in (Martens, 2006). Moreover, Martens (2006) noticed that there are four characteristics of sustainable development. First, the *intergenerational* phenomenon, it means that we have to take into account at least next two generations. Second, *level of scale* means sustainable development is ranging from global, regional, to local levels. Third, sustainable development indicates *multi domain* characteristics that at least consist of three pillars: economic, ecological, and socio-cultural domain. Finally, sustainable development is characterized by *multi interpretation*.

From the discussion above, sustainability concept and sustainable development is still a broad definition, which can be translated into programs or projects differently, based on the perception of actors involved in the decision making process and local characteristics. There are several aspects in sustainability concept that will be used in this research as criteria of assessment: economic, social, ecological, and institutional. The focus of "sustainability" concept can be concluded as the inter-generational concern of resource usage based on the social agreement in some aspects: ecological, social, economic and institutional.

Ecological Aspect of Sustainability

Ecological or environmental aspect of sustainable development is an ecocentric point of view in which interest of life as a whole is the main focus (Hoekstra, 1993). Spangenberg (2004) describes environmental sustainability as either referring to current environmental problems or the longer term perspective – the need to reduce the total use of physical resources of the economy. There are three main resource categories with this respect: energy consumption, material flows and land use. These categories are believed to be the driving forces on environmental problems. Hence, these categories should become core considerations for environmental sustainability indicators (Ibid, 2004).

Social Aspect of Sustainability

In their classic article, Meadows and Randers (1991) define social sustainability as "one that can persist over generations, one that far seeing enough, flexible enough, and wise enough not to undermine either its physical or its social systems of support". They also define sustainable society from the system point of view as "one that has in place informational, social and institutional mechanism to keep in check the positive feedback loops that cause exponential population and

capital growth". It means that the combination of population, capital, and technology in the society can be configured so that the material living standard is adequate and secure for everyone.

Hoekstra (1993) argues that social well being can not be achieved only by the optimizing of the individual well being, but it also consider the relations between individuals. There are four main values in assessing the well being of a society: democracy, peace, use or division of common property and availability of common facilities. Regarding to the sustainability, only the third value (use of division of common property) is used as the assessing tool because it is closely related to the usage of resources.

Economic Aspect of Sustainability

From an economic perspective, the region (watershed) may appear to be a sort of environmental services to be optimized for human uses (Blomquist and Schlager, 2004). Hoekstra (1993) argues that individual well being is related to two buzz words "well being" and "quality of life". Spangenberg (2004) notices that the economic growth is obstructed by the social and environmental dimensions of sustainable development. There is a normative limitation in economic growth in order to reduce the environmental degradation for countries, 5-6% for developing countries and 3-4% for developed countries to achieve distributional equity in countries all of the world. Neoliberal economists rejected the limitation of the economic growth by argument that: the more growth, the better for all members of society and in all respects (Economists, 2000) in Spangenberg (2004). I believe that the tension between economic and environment can be reduced by social agreement supported by scientific argumentation in which "quality of life" in this generation can be improved without disturbing next generation's "well being".

Institutional Aspect of Sustainability

Spangenberg (2004) redefines the political institutions as the rules by which political decision making and implementation is structured. These rules do not include the general expectations guiding the behavior of a society, its values, ideals and principles, but "*social capital*" of societies provided by the broad range of institutional settings below this level, including orientations and mechanisms for decision making and organizations for rule enforcement. Social capital refers to the institutions, relationship, and norms that shape the quality and quantity of a society's interaction (Spangenberg, 2004). Healey (1999, p.61) uses term "*institutional capacity*" in describing the quality of relational networks in a place. This term is developed in the regional economic literature but it is also useful in sustainable development, biospheric sustainability or quality of life. According to Agenda 21, the core institutional objectives are accountability, civil society empowerment, gender equity and knowledge formation (Spangenberg, 2004).

2.2 Watershed Management

World Discourse on Water Management

The Period of Growing Environmental Concern on Water

In 1962, Rachel Carson's publication of *Silent Spring* was seen as the turning point in public views about the environment in general and about water in particular (Heathcote, 1998). Carson's *Silent Spring* concerned on the rapid deterioration of water quality and the role of industrial polluters in that decline. It influenced the governments around the world to establish stronger environment-protection legislation, more efficient administrative structures, and better oversight of public and private water users.

In 1977, a conference on water at Mar de Plata, Argentine sponsored by United Nations (UN) was the landmark event in water management, which resulted in an action plan, including recommendations targeted at meeting the goal of safer drinking water and sanitation for all human settlements by 1990. This action plan emphasizes a strong, centralized, and national commitment to water management. But, after 20 years, the problems it was intended to solve remain significant. Lee (1992) in (Heathcote, 1998) noticed some difficulties continuing to exist: (1) the dominance of unregulated water uses, (2) inadequate and ineffective water resource management, (3) a high degree of inefficiency in many water-related public utilities, (4) a failure to retain trained staff of all types, (5) over centralization and bureaucratization of decision making authority and (6) inappropriate and inadequate water legislation.

In this period, water is still seen as a common good in which the responsibility of water management is shared. The regulations made by the government can minimize the environmental degradation causing externalities. The use of common resources maximally by some users will reduce others to use the same resources. In economic terms (Wikipedia, 2006), common good is related to competitive non excludable goods Competition is the act of striving against another force for the purpose of achieving dominance or attaining a reward or goal, or out of a biological imperative such as survival. Non-excludable goods are defined in economics as goods whereby it is impossible to stop a person consuming that good when it has become publicly available at a relatively low cost. Non-excludable types of goods include public goods and common pool goods.

The Period of Changing Perspective on Water

Rahaman and Varis (2005) identify other important event on water management, the International Conference on Water and the Environment (ICWE) held in Dublin, in 1992, in Ireland to serve as the preparatory event, with respect to water issues, to the Rio United Nations Conference on Environment and Development (UNCED) Conference. There are some key principles proposed in the conference, as follows:

- Principle one recognized fresh water as a finite, vulnerable, and essential resource, and suggested that water should be managed in an integrated manner.
- Principle two suggested a participatory approach, involving users, planners, and policymakers, at all levels of water development and management.

- Principle three recognized women's central role in the provision, management, and safeguarding of water.
- Principle four suggested that water should be considered as an economic good.

Water professionals from developing world opposed the forth principle because water development initiatives could not be sustainable if water is considered as an economic good without considering issues of equity and poverty (Rahaman and Varis, 2005). Principles one to three are the success work of the conference by promoting integrated water management on active participations of all stakeholders, from the highest levels of government to the smallest communities, and highlighted the special role of women in water management. The Dublin conference recommendations were later consolidated into Chapter eighteen of Agenda 21 in Rio de Janeiro, 1992.

Unlike Mar de Plata, the participants of Dublin conference are merely experts in water area from developed countries but not the intergovernmental agencies from developing world. Hence, the water professionals from developing world question the effectiveness of the principles to be implemented in developing world with all of the complex problems they face.

The first well participation conference was held in the world water forum in The Hague in 2000. Not only experts and governments participate in the conference, but also all stakeholders related to water from both developed and developing countries (Rahaman and Varis, 2005). By its theme *From Vision to Action,* the focus of the conference is the *framework for action*.

The Hague Forum agreed to carefully consider the acknowledgement of water's social, environment, and cultural values from the previous water initiatives. The participants promote the equity criteria together with the appropriate subsidies to the poor, when systematically adopting the full-cost water pricing. The Forum also called for institutional, technological, and financial innovations; collaboration and partnership at all levels; meaningful participation of all stakeholders; establishment of targets and strategies; transparent water governance; and cooperation with international organizations and the UN system.

In this period, there was a shift perspective in water from "common good" to "economic good" in developed countries due to the transparency and effective aspect of water management (Diecke, 2001). In contrary, there was also rejection of this perspective in some developing countries which have limited money in building infrastructure and limited affordability to pay from the poor.

The Period of Sustainable Water

In 2001, International conference on freshwater was held in Bonn in order to solve world water problems and prepare the materials for the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002 and third water forum held in Kyoto in 2003. *The Bonn Keys* highlighted the key steps toward sustainable development through meeting water security needs of the poor, and promoting decentralization and new partnerships.

In 2002, WSSD was held in Johannesburg, South Africa. The forum put Integrated Water Resource Management (IWRM) at the top of the international agenda. The WSSD's Plan of Implementation includes IWRM as one of the key

components for achieving sustainable development (Rahaman and Varis, 2005). Targets and guidelines are made to implement the IWRM worldwide, including: (1) developing an IWRM and water efficiency plan by 2005 for all major river basins of the world; (2) developing and implementing national/regional strategies, plans, and programs with regard to IWRM; (3) improving water-use efficiency; facilitating public-private partnerships; (4) developing gender-sensitive policies and programs; (5) involving all concerned stakeholders in a variety of decision making, management, and implementation processes; (6) enhancing education; and combating corruption.

Watershed Management

Grigg (1996, p. 355) argues that the term "watershed management" is related to the *sum of actions taken to preserve and maintain watersheds*. The watershed management as an appropriate unit for resource planning and management began in the 1800's (Worster, 2003 in Blomquist and Slagher, 2005). Recently, the trend towards more regional management and planning in water is applied in some countries. Over the past twenty years, a strong global consensus has begun to develop around the notion that the watershed is, in fact, the best unit for the management of water resources (Heathcote, 1998). Recent movement of watershed management approach in water management is based on the new processes for comprehensive and integrated decision in which every party related to water fairly include in the decision making (Blomquist and Slagher, 2005). Heathcote (1998) argues that the integrated watershed management is relatively new in adopting "ecosystem" approach as trans-media environmental management due to the unsuccessful approach in the water management approach in the past, which focused primarily on single medium (water).

Commission for Environmental Cooperation (CEC) in North America (2001) indicates some reasons why watershed is an appropriate approach in water resource management by structuring policy, planning and management:

- Due to its unique properties, water integrates and catalyzes other biophysical processes in the air, land and water environment.
- Watersheds define distinct biophysical units
- Watersheds are an easy-understood ecosystem unit
- The health of rivers and streams is both influenced by and illustrative of the health of the lands through which they flow
- Water systems demonstrate the cumulative effects of environmental stresses
- Quality of life is directly linked to water quality in the watersheds
- Most management actions can be integrated using watersheds, at some scale, as a common planning unit, and
- There is a strong and growing public support for implementation at the local watershed level

According to Goldfarb and William (1994), recently, watershed management is used as an approach in water management regarding some problems in legal institutions of water resource management in the USA: a) inter region water management problems, b) implications of decentralization (federalism and separation of powers), and c) inconsistency of water law among political units. Woltjer (2006) illustrates the trend toward strategic approach to regional water planning in Europe

emphasizing on the need of cooperation between countries due to the interdependencies within international river basins. The Water Framework Directive made by EU has also an indication towards river basin as a planning and management unit of water resource.

Even though integrated watershed management has long been recommended, there are many perceptions on how to develop and implement watershed-based policies and programs (McGinnis, 1999 in Blomquist and Slagher, 2005). This implies the existing water problems related to watershed management. Thus, the general standard needs to be developed to ensure the "best practice" management to be applied in the watershed in order to achieve sustainable watershed management.

Watershed Institution

Livingston (1995) points out that good water institution can facilitate achievement of both economic and social goals. Efficient water use requires the secure and flexible system of water rights. Thus, institutional design is specific on each area based on the physical characteristic of its water resources. Bandaragoda (2000, p.4) defines the institution as "*constituent rules of society"* or "*rules of the game*" in which consists of (1) policies and objectives, (2) laws, rules and regulations, (3) operational plans and procedures, (4) incentive mechanisms, (5) accountability mechanisms, and (6) norms, traditions, practices and customs. In addition, Bandaragoda (2000) distinguishes between institution and organization and their relations, and he also describes the two perceptions regarding this relation. First, it focuses on the how organizations come into existence and how they evolve is fundamentally influenced by the institutional framework. Second, it focuses on the established organizations, such as water board, river basin organization etc., are in fact institution in which their sets of norms and behavior are valued and useful.

Bandaragoda (2000) then notices that institutional framework for water management consists of rules, norms, practices and organizations providing a structure to human actions related to water management. Organizations are subset of institutions, and for practical purposes, the institutional framework is considered to be three categories: policies, laws and administration related to water resources management in a watershed context. Because there are many groups and users in water resources, an appropriate institution should be generated to make an effective planning and implementation of equitable, efficient and sustainable use of natural resources in watershed context. This requires valid information of physical, social, environmental, economic and institutional parameters of the watershed that can be assessed by stakeholders equitably. Due to the complex problems in watershed related to many actors involved, the high degree of coordination is needed.

Issues related to local environment can easily be identified by local community. This information can be shared through effective community participation in which brings about empowerment of the people, enables them to take their own decisions in an agreed framework rules (Bandaragoda, 2000). There are several requirements of public participation before ensuring legitimacy and credibility for science decisions (Water International, 1999): (1) public should have a say in decisions about actions that affect their lives, (2) public participation includes the promise that the public's contribution will influence the decision, and (3)

fulfilling an effective public participation conditions: facilitate the involvement of affected party, provide meaningful information, creates a forum of all community, scientists, and decision makers.

The appropriate institutional setting for watershed management ensures the good condition in achieving economic, social and ecological goals and the integration of these aspects. Coordination and cooperation among stakeholders can be done in an effective institution based on local condition. The analysis of institutional setting in the case study will elaborate the efforts of the government in achieving sustainable watershed management.

Watershed Management Planning

Watershed Management Planning plays an important role in ensuring the actions to be applied in watershed based on sustainability concept in which on one hand, water and other resources must be available in continuously in appropriate quantity and quality, but on the other hand, economic and social development should be given enough concern.

Policy style of watershed management plan consisting of some administrative area can be included into hybrid policy style in which both "command and control" and "participatory" are used as an approach in the planning process. Moss (2003) indicates the Water Framework Directive (WFD) in the European Union (EU) as this policy style. The expressions of "command and control" approach in WFD, for example, are detailed specifications on content and procedure for the river basin management plans and programs of measures, strict monitoring and reporting obligations, reduction of hazardous pollutants and environmental quality objectives on water. In contrary, the "participatory" approach can be seen for example as requirements for transparency in implementing WFD and practicing river basin management, involvement of the public, flexibility in time of implementation, cost efficiency in achieving goals, and sensitivity to regional specifics such as natural, socio-economic, and institutional.

2.3 Sustainability Concept in Water Management

Hoekstra (1993) indicates that to apply sustainability concept in planning process of water resource management, there should be an agreement achieved by politicians and scientist in the inception stage (early stage) about the variables to be taken into account based on values and scientific justifications.

Integrated Water Resource Management (IWRM)

As promoted in WSSD in Johannesburg, IWRM is the key in achieving the sustainable development in water issue. Some scholars have discussed the key successes in achieving IWRM practices. For example, Rahaman and Varis (2005) argue that there are seven factors that should be considered by water professionals in achieving success IWRM:

1. Privatization

Basically privatization of water seems to be a good idea because it discourages subsidies and in turn can optimize efficiency. But as mandated by

IWRM, privatization can make fragmentation in which may result in doubt ness in transparency. In developed countries like Europe where water infrastructure is subsidized massively, the idea of privatization is questioned. In developing world, where the basic infrastructure is not yet complete, the question remains whether applying full cost recovery is ethical or practical.

2. Water as an Economic Good

Discussion, analysis, study, and commitment are needed in deciding whether water is a common or an economic good because changing water into economic good is also changing perception of the public from common good in which the duty and responsibility is shared. A straightforward solution based on pure economic efficiency may cause unsustainable condition. In developing world where water is scarce and difficult to access, the idea of water as an economic good should have more discussion.

3. Transboundary River Basin Management

Water can be seen as a tool for community development, peace building, and preventive diplomacy. Cooperative watershed management is essential for incorporating all physical, political, and economic characteristics for watershed. Based on this reason, water should be managed in watershed, not only on administrative boundary. The consideration to implement river basin management has been promoted in the Hague forum, the Bonn conference, and the WSSD summit. Nevertheless, there is still not clear about how to implement river basin concept into practice. Sustainability implies closer cooperation between water users than has typically been experienced in the past. It also implies consideration of the needs of the community, not just the individual – a difficult proposition for many water users (Heathcote, 1998)

4. Restoration and Ecology

Recently, the environmental degradation particularly in US and Europe has been influence the public policy awareness of the water channel and resulting in the restoration of river policy. The term "chanellization" is used to encompass all process of river channel engineering for the purpose of flood control, drainage improvement, maintenance of navigation, reduction of bank erosion, and relocation for highway construction. Some issues related to this "channelization" such as construction, land use change, urbanization, and waste disposal, creates wide range of biological impacts, such as benthic vertebrates, fish, and aquatic vegetation. Unfortunately, IWRM principles do not clearly focus on the river restoration issue which is necessary for sustainable water resource management, especially for the modified water channel.

5. Fisheries and Aquaculture

Fisheries and aquaculture provide protein and nutritional demands in many parts of the world and many people rely on these to survive. Therefore, the fisheries and aquaculture has become a special attention in IWRM, particularly where many people are depend on these as their survival.

6. Need to Focus on Past IWRM Experience – Integrating Lessons Learned

Some lessons in the previous practice in IWRM could enlighten the implementation of IWRM today. The past initiatives can help policy makers considering properly similar issues of IWRM. For example, today's IWRM plans

adopt the comprehensive watershed plans used in the 1970's in the European countries.

7. Spiritual and Cultural Aspects of water

Woltjer (2006, p 106) argues that water body can symbolize the quality of life, culture, and identity of territory. Rahaman and Varis (2005) identify water as the symbol of humanity, social equity, and justice. For example, the Ganges River in South Asia has a very strong spiritual and cultural significance to all Indians, Bangladeshis, and Nepalese. Without considering these cultural and spiritual aspects of water, all efforts toward sustainable water resources management may be bit by bit and temporary.

The issues described above are also become consideration in water professionals in Indonesia. The Water Act No 7/2004 implies that these issues also exist in Indonesia and need to be addressed appropriately. In article No 3 of the Act, it is stated that water resources are managed in comprehensive, integrated and environmentally friendly aiming at sustainable use of water resources for humans well being.

2.4 The Application of Sustainability Concept on Watershed Management in Some Countries

Grigg (1996) argues that the scenarios for watershed management should be approached on a case by case basis. River sizes, location, institutional structure, ecology, development, and other natural and man-made characteristics makes differences. Actors involved in each watershed are also different. Thus, they have different values, needs, and preferences regarding water issue.

Stories from some countries will be elaborated briefly to enrich the insight of the research, particularly about lessons that can be learned in other countries regarding sustainable watershed management. The good condition of watershed by preserving natural resources can be seen as a key towards sustainable development. Thus, elaboration on watershed management guaranteeing the good condition of natural environment by optimizing the use of land and water in watershed in some countries can draw some lessons on sustainability.

United States

The river basin became a planning unit in US in 1927 when the US Army Corps of Engineers studied multipurpose river basin development authorized by the Rivers and Harbors (Grigg, 1996). Then, in 1933, US established a very famous experience in river basin management called the Tennessee Valley Authority aimed at infusing an underdeveloped region with economic and social development. There were two debates during the TVA establishment. First, the debates between public and private power, and the second is the debate about water development itself. Both debates are based on the infatuation of President Franklin Roosevelt, the concept of "regional planning".

The changing approach in water management in US towards river basin approach gave consequence on the role of federal government in water management, which was reduced and replaced by the bigger role of share responsibility of state and local governments.

There are some roles in river basin management: providing services, regulating, planning and coordinating, and providing support. Service providers are responsible for protecting the interests of the customers including environment and downstream customers. The planners and coordinators play a role to facilitate the service provision and to minimize regulation, considering all customers and socio-economic and environment objectives. Regulators contribute in coordinated planning, hoping to achieve the desired results without imposing the final measure, regulation.

The clear job division of each actors involved in the river basin management and the acceptance of each actors in the new concept of regional planning introduced by the President are the key component in achieving the success of TVA.

Europe

1. Baltic Basin

In Baltic watershed encompassing five countries in Europe, Janson and Stalvant (2001) argue that as a consequence of adopting sustainability, an area should use the holistic view, working with dynamic systems – watersheds, lakes, seas, including humans. It requires the common understanding of all stakeholders in visioning the dynamics of interacting elements of the system.

Janson and Stalvant (2001) highlight the need of concrete action of the environmental consideration in among people and the need of the consideration of the people as a part of whole system in environment. In Poland and Estonia, the management of environmental quality in the watershed follows the environmental standards of EU, while some countries (Finland and Sweden) have self chosen and high profile of sustainability performance. The institutions exist in the regional level with coordinated actions in line with cooperation programs with relevance for environmental protection of marine environment under the Helsinki Commission and the Baltic Sea Agenda 21.

There are two indicators available illustrating how sustainability policies pursued on the regional encroach on and giving meaning to ecosystem development: the policy of natural reserves and the distribution of hot spots within the four subsystems. The natural reserves are areas of special values that should be protected against human disturbance. It was a tradition to protect or enhance special ecosystems that serve unique functions and to set aside critical habitats. The improvement of the spots in the watersheds has significant progress with various emission and substances in many spots, but some plants and many agricultural production units have still not been affected. The rethinking in management of philosophy is affected not only by researches in sustainability issues but also by EU water directive and collateral policies.

2. The Application of Water Framework Directive (WFD) in some Countries

Water Framework Directive in EU has some implications on the water management in EU countries related to sustainable development. WWF (2001) indicates that the WFD is the"*EU's fist sustainable development directive"* if it can be applied completely and timely manner. It is because the WFD insists the EU members to manage water in the basin scale in which all aspects related to water includes in the management.

WWF (2001) identifies some benefits by applying WFD: (1) improved ecological quality of European freshwater and coastal water ecosystems, (2) biodiversity gains (through better management of aquatic and wetland habitats/species), (3) improved sustainability of water use (through more efficient water resource use and management), (4) reduction of water pollution, (5) mitigation of the effects of floods and drought, and (6) improved efficiency and effectiveness of water policy, with better targeting and reduced costs.

WWF in the seminars of water series (2001) grasps some lessons from the practice of WFD in some countries. For example, in Danube and Rhine basins, Europe largest basins, the coordination of policy and action within common framework has been established by inter-governmental river basin commissions. The commissions in Danube basin includes experts group on river basin management which is responsible for taking forward elements of the technical work required under the WFD, for example identification of the Danube RDB, coordinating analysis of the RDB characteristics, identifying pressures and impacts, and developing mapping and reporting procedures (WWF, 2001). In the Rhine and Meuse basins, the political consensus achieved on long term program the "Rhine 2020" and short term "action plan" was impressive success story. The program is both the flood risk reduction and the works with nature.

Mexico

In San Cristobal watershed, Mexico, the framework of sustainable watershed management plan has developed by project conducted by Bencala et al (2006) to provide stakeholders with a framework for solving the problems and a toolset that will aid them in making informed decisions. The frameworks includes some tools: watershed model, water quality monitoring, best management practices (BMP), and wastewater treatment options. Watershed model is aimed at gaining insight of the local watershed processes and potential impacts of various management series. The model is developed based on the available data from the conceptual understanding of hydrological processes within the watershed and its responses to management scenarios including population growth, BMP implementation, and the maintenance of the status quo.

Water quality monitoring program was designed to provide the better understanding of the sources, amounts, movement, and fluxes of contaminants within the region. The program indicates a mechanism and methods for data collection and analysis, sampling locations organized by priority, suggested sampling frequency, and estimated costs of resources. Review of BMP explored alternatives to solving San Cristobal's myriad of water related problems including stormwater runoff, soil erosion, nitrogen and phosphorus loading, sedimentation, surface water contamination, aquifer depletion, and shortages of drinking water. These strategies are evaluated by some criteria addressing multiple concerns, potential pollutant load reductions, physical land requirements, and cost.

Wastewater Treatment Options determine the implementation of a large scale treatment system to meet national standards on water quality. The options includes: a variety of lagoon systems, constructed wetlands, intermittent filtration systems, and conventional wastewater treatment plants. Some questions have to be answered to meet the feasibility of the options, such as: how much wastewater

produced; what is the pollutant load of the wastewater; what future population should be planned for; where is the most suitable location for a treatment facility.

2.5 Concluding Remarks

The unclear and ambiguous concept of sustainability can be approached by "social agreement" which can reduce the uncertainty to be more certainty. The dimensions of sustainability are economic, social, ecology and institution. Economic aspect refers to the "quality of life" and "well being" (Hoekstra, 1993). Social aspect focuses on the relations between individuals in perceiving the use of resources (Meadows and Randers, 1991). Spangenbarg (2004) argue that the environmental sustainability is related to current environmental problems or longer term perspective of the need to reduce the use of physical resources of the economy. At last, the institutional dimension of sustainability describes the orientations and mechanisms for decision making for rule enforcement (Spangenbarg, 2004).

There are at least three periods of water management in the world discourses: *the growing environmental concern, changing perspective on water,* and *sustainable water* reflected in some world water forums. In the first period, water is seen as common goods in which the responsibility of water management is shared. In the second period, there was a shift of water perspective as "economic good" in order to manage water more transparent and efficient. The last period focuses on the sustainable water where water should be available in good quality not only for us now, but for them in the future.

The implication of these world water forums is the use of basin/watershed as a management unit in water. There are several reasons why watershed is chosen as the unit of management of water. First, water can integrate and catalyze other biophysical processes in the air, land and water environment. Second, due to its clear distinct biophysical unit, ecosystem processes can be easily understood in the watershed. Third, the health of rivers implies the health of land through which the water flows. Forth, water system can demonstrate the cumulative effects of environmental stresses. Fifth, the quality of life is directly link to water quality in the watershed. Sixth, most management actions can be integrated using watersheds, at some scale, as a common planning unit. And seventh, the strong growing public support for implementation at the local watershed level is an important consideration. These reasons are devoted to address some issues such as inter region management problem, decentralization, and inconsistency of water law among political units.

The application of sustainability concept in the water management varies in some countries. In the US, water management is shared responsibility among actors including service providers, planners and coordinators and regulators. The clear job division of each actor involved in the river basin management and the acceptance of each actor in the new concept of regional planning introduced by the President are the key component in achieving the success of TVA. The Baltic Basin in Europe applies sustainability concept by holistic view, working with dynamic systems – watersheds, lakes, seas, and humans. EU Water Framework Directive (WFD) is believed to be the"first sustainable development directive" (WWF, 2001) in which all aspects related to water includes in the management. The unit management of water

is in basin scale. The framework for sustainable watershed management is Mexico includes some tools: watershed model, water quality monitoring, best management practices (BMP), and wastewater treatment options (Bencala et al, 2006). The watershed managements applied in many countries indicate the efforts in achieving sustainable development, by focusing on the impact on environment as a result of human activities at present should not impede the future generations to meet their needs by integrating many variables related to water issues.

Chapter 3 Sustainability Assessment and Indicators of Sustainable Watershed Management

In chapter 2, the concept of sustainability and watershed management are described as a basis in the understanding of both concepts and their implications. This chapter elaborates the assessment of sustainability in theoretical point of view. Several approaches developed by some scholars are described. Criteria and indicators for sustainable development are described to extract the criteria and indicators for sustainable watershed management. The ideal and legal criteria and indicators are explained as a reference in developing the criteria and indicators used in this research. In the end of this chapter, the selection of criteria and indicators used for the assessing the case study are defined.

3.1 Sustainability Assessment

To assess whether a program, plan, and policy applying sustainability concept or not, an assessment method is needed. Some scholars have developed methods called "sustainability assessment" as an effort toward achieving sustainability. Martens (2006) argues that sustainable development needs new methods and techniques to be developed before the integrated analysis of sustainability can be agreed. The characteristics of those methods are: from supply-driven to demand-driven, from technocratic to participant, from objective to subjective, from predictive to exploratory, and from certain to uncertain. The integrated assessment of sustainability of policy can be assessed by following procedural elements: analysis of deeper lying structures of the system, projection into the future, and the assessment of sustainable and unsustainable trends, evaluation of the effects and design of the possible solutions.

Pope *et al* (2004) divides two approaches in assessment for sustainability criteria. First, the *bottom up* approach in which objectives are defined in relation to baseline conditions assuming that simultaneous achievement of a series of environmental, social and economic goals or objectives defines a state of sustainability. This approach has a problem in knowing how to judge when extension has reached far enough to achieve goal of sustainability. Second, the *top down* approach in which the state of sustainability is defined as a start to define sustainability criteria. This research will use the *top down* approach, which defines the sustainability criteria based on the state of sustainability. For this purpose, the indicators of sustainability are developed.

Moreover, Pope *et al* (2004) argues that the sustainability assessment is originated from the environmental assessment process including Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA). In particular, there is a practical difficulty of integrating environmental, social and economic considerations in a way that fully interacting each other and avoiding trade off.

Sustainability assessment is also related to evaluation methods referring to both effectiveness and efficiency of programs or projects including plans in achieving

goals. Roberts (2006) divides evaluation into three types: *ex ante* (evaluation before the programs applied), *mid term* (evaluation in the process of programs application) and *ex post* (evaluation of whether the goals have achieved or not). The assessment on sustainability can be done in those three types of evaluations. This research will use the ex ante evaluation by evaluating the master plan made by EACJP in 2003. Before applying the master plan, the evaluation is needed to assess whether the master plan is following the sustainability concept or not. The formulation of sustainability assessment has been discussed by some experts, for example Hardy and Zdan (1997) in Bossel (1999, p.15) that propose the guidelines in practical level called Bellagio Principles. These principles are:

1. *Guiding Vision and Goals.* The assessment should be guided by a clear vision of sustainable development and goals that define that vision
2. *Holistic Perspective.* The assessment should (a) include review of the whole system as well as its parts; (b) consider the social, ecological and economic well being, their state as well as the direction and rate of change of the state, of their component parts, and the interaction between parts; and (c) consider both positive and negative consequences of human activity in a way that reflects the costs and benefits for human and ecological systems, both in monetary and non-monetary terms.
3. *Essential Elements.* The assessment should (a) consider equity and disparity within the current population and between present and future generations, dealing with such concerns as resource use, over consumption and poverty, human rights, and access to services, as appropriate; (b) consider the ecological conditions on which life depends; (c) consider economic development and other non-market activities that contribute to human and social well-being
4. *Adequate Scope.* The assessment should: (a) adopt a time horizon long enough to capture both human and ecosystem time scales, thus responding to current short-term decision making needs as well as those of future generations; (b) define space of study large enough to include not only local but also long distance impacts on people and ecosystems; (c) build on historic and current conditions to anticipate future conditions: where we want to go, where we could go
5. *Practical Focus.* The assessment should be based on: (a) an explicit set of categories or an organizing framework that links vision and goals to indicators and assessment criteria; (b) a limited number of key issues for analysis; (c) a limited number indicators or indicator combinations to provide a clearer signal of progress; (d) standardizing measurement wherever possible to permit comparison; (e) comparing indicator values to targets, reference values, ranges, thresholds or direction of trends, as appropriate
6. *Openness.* The assessment should: (a) make the methods and data that are used accessible to all; (b) make explicit all judgments, assumptions and uncertainties in data and interpretations
7. *Effective Communication.* The assessment should: (a) be designed to address the needs of the audience and set of users; (b) draw from indicators and other tools that are stimulating and serve to engage decision-makers; (c) aim, from the outset, for simplicity in structure and use of clear and plain language

8. *Broad Participation*. The assessment should: (a) obtain broad representation of key grassroots, professional, technical and social groups, including youth, women and indigenous people to ensure recognition of diverse and changing values; (b) ensure participation of decision-makers to secure a firm link to adopted policies and resulting action.
9. *Ongoing Assessment*. The assessment should: (a) develop a capacity for repeated measurement to determine trends; (b) be iterative, adaptive and responsive to change and uncertainty because systems are complex and change frequently; (c) adjust goals, frameworks and indicators as new insights are gained; (d) promote development of collective learning and feedback to decision-making
10. *Institutional Capacity*. Continuity of assessment should be assured by: (a) clearly assigning responsibility and providing ongoing support in the decision-making process; (b) providing institutional capacity for data collection, maintenance and documentation; (c) supporting development of local assessment capacity.

3.2 Developing Indicators of Sustainable Development

Basically, the general steps in generating indicators of sustainable development can be seen in **Figure 3.1** (Lorenz et al, 2001). It begins with the definition of information needed in developing the conceptual model. Then, formulation of potential indicators is developed to be tested by scientific basis, policy relevance, and measurability. The availability of data will determine the indicators selected. The sufficient data will directly develop the indicators, but the insufficient data needs monitoring and questionnaire to complement it. In this research, the reliability on data is very essential and due to the limit of time, the monitoring and questionnaire are not conducted.

Lorenz et al (2001) identifies the potential indicators as dominant processes and characteristics in the conceptual model defined as verbal or visual elaboration of a part of the world from certain point of view. For example, the information on the system, its spatial and temporal scale, and the cause-effect chain can be put into the conceptual model representing the environmental problems.

Then, Lorenz et al (2001) proposes *pressure-state-impact-response* framework to describe cause-effect between human use and the river. Pressure refers to human activities and its influence on the environment. State refers to ecosystem functioning. Impact refers to effect of a change of state to the supply of environmental goods and services. Then, response refers to societal response to environmental changes.

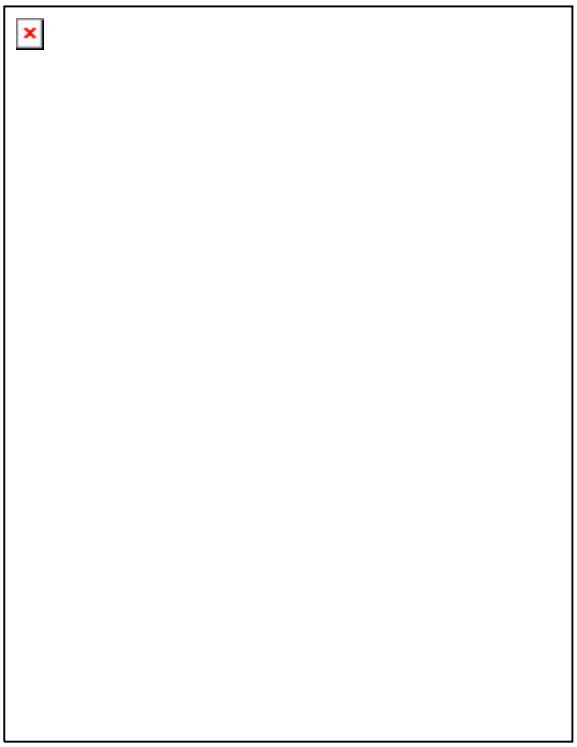

Figure 3.1 Schematic representation of the process of indicator selection
Source: Lorenz et al (2001, p.119) adapted from Verhallen (1995)

Commission on Sustainable Development (CSD), after conducting workshop contributed by many countries, proposes theme indicator framework as a general guideline to develop sustainability indicators (UNDSD, 2001). These indicators (see **Table 3.1.**) are relevant to assess many programs or plans developed in many countries. The most appropriate indicators will be selected, based on the data availability, as sustainable watershed management indicators in the end of this chapter to be used in chapter 5. The indicators developed by CSD below can be seen as **ideal** indicators in assessing sustainability. The legal indicators will be described in the next sub chapter.

Table 3.1 Indicators of Sustainability (Ideal)

ENVIRONMENTAL		
Theme	**Sub-theme**	**Indicator**
Atmosphere	Climate Change	Emissions of Greenhouse Gases
	Ozone Layer Depletion	Consumption of Ozone Depleting Substances
	Air Quality	Ambient Concentration of Air Pollutants in Urban Areas
Land	Agriculture	Arable and Permanent Crop Land Area
		Use of Fertilizers
		Use of Agricultural Pesticides
	Forests	Forest Area as a Percent of Land Area
		Wood Harvesting Intensity
	Desertification	Land Affected by Desertification
	Urbanization	Area of Urban Formal and Informal Settlements
Oceans, Seas and Coasts	Coastal Zone	Algae Concentration in Coastal Waters
		Percent of Total Population Living in Coastal Areas
	Fisheries	Annual Catch by Major Species
Fresh Water	Water Quantity	Annual Withdrawal of Ground and Surface Water as a Percent of Total Available Water
	Water Quality	BOD in Water Bodies
		Concentration of Faecal Coliform in Freshwater
Biodiversity	Ecosystem	Area of Selected Key Ecosystems
		Protected Area as a % of Total Area
	Species	Abundance of Selected Key Species

SOCIAL		
Theme	**Sub-theme**	**Indicator**
Equity	Poverty	Percent of Population Living below Poverty Line
		Gini Index of Income Inequality
		Unemployment Rate
	Gender Equality	Ratio of Average Female Wage to Male Wage
Health	Nutritional Status	Nutritional Status of Children
	Mortality	Mortality Rate Under 5 Years Old
		Life Expectancy at Birth
	Sanitation	Percent of Population with Adequate Sewage Disposal Facilities
	Drinking Water	Population with Access to Safe Drinking Water
	Healthcare Delivery	Percent of Population with Access to Primary Health Care Facilities
		Immunization Against Infectious Childhood Diseases
		Contraceptive Prevalence Rate
Education	Education Level	Children Reaching Grade 5 of Primary Education
		Adult Secondary Education Achievement Level
	Literacy	Adult Literacy Rate
Housing	Living Conditions	Floor Area per Person
Security	Crime	Number of Recorded Crimes per 100,000 Population
Population	Population Change	Population Growth Rate
		Population of Urban Formal and Informal Settlements

ECONOMIC		
Theme	**Sub-theme**	**Indicator**
Economic Structure	Economic Performance	GDP per Capita
		Investment Share in GDP
	Trade	Balance of Trade in Goods and Services
	Financial Status	Debt to GNP Ratio
		Total ODA Given or Received as a Percent of GNP
Consumption and Production Patterns	Material Consumption	Intensity of Material Use
	Energy Use	Annual Energy Consumption per Capita
		Share of Consumption of Renewable Energy Resources
		Intensity of Energy Use
	Waste Generation and Management	Generation of Industrial and Municipal Solid Waste
		Generation of Hazardous Waste
		Generation of Radioactive Waste
		Waste Recycling and Reuse
	Transportation	Distance Traveled per Capita by Mode of Transport

INSTITUTIONAL		
Theme	**Sub-theme**	**Indicator**
Institutional Framework	Strategic Implementation of SD	National Sustainable Development Strategy
	International Cooperation	Implementation of Ratified Global Agreements
Institutional Capacity	Information Access	Number of Internet Subscribers per 1000 Inhabitants
	Communication Infrastructure	Main Telephone Lines per 1000 Inhabitants
	Science and Technology	Expenditure on Research and Development as a Percent of GDP
	Disaster Preparedness and Response	Economic and Human Loss Due to Natural Disasters

Source: UNDSD (2001)

It is widely accepted that sustainability indicators are the useful and thought-useful series of standards in assessing the sustainability concept applied in policies and programs. Spangenbarg (2002, p.105) defines sustainability indicators as "simplifying communication tool" to guide political decision making towards sustainable development. Thus, sustainability indicators should reduce complexity, understandable, and limited in number indicated by its attributes: general, indicative, sensitive and robust. But, Buckingham-Hatfield and Evans (1996) criticize that there is a recognition that the achievement of these indicators sometimes does not mean that it is equal with the achievement of the sustainability. Nevertheless, the effort to achieve sustainability by testing the indicators is still a relevant method to be used.

The Framework for Sustainable Development Indicators (EU)

The purpose of indicators is to monitor progress achieved by the implementation of policy measures towards policy goals and objectives CEC (2005). The EU has set themes regarding sustainable development adapted from the indicators development in some agreements such as Lisbon process, Millennium Declaration, etc, into 10 themes: economic development, poverty and social exclusion, ageing society, public health, climate change and energy, production and consumption patterns, transport, good governance, and global partnership.

CEC (2005) divides Sustainable Development Indicators (SDI) into three layers of priorities to facilitate the communication about SDI. Level 1 focuses on a high level policy making and general public and can be seen as a set of headline indicators. Level 2 underpins the evaluation of the core policy areas and communication with general public. Level 3 highlights the further policy analysis and better understanding of the trends and complexity of issues associated with the theme or inter-linkages with other themes in the framework.

Requirements for Developing Indicators of Sustainable Development

The threats for sustainability of a system require urgent attention if their rate of change begins to approach the speed with which the system can adequately respond Bossel (1999). When the rate of change is over the ability to respond, then the system loses its viability and sustainability. Recently, the dynamics of technology, economy and population speeding up the environmental and social change are factors threatening humankind sustainability.

Bossel (1999, p 1) also states that *sustainability in an evolving world can only mean sustainable development*. Thus, the appropriate practical dimension of sustainability translated from concept manifested in indictors of sustainability needs to be developed to tell us where we stand within our goal. The goal of sustainable development is translated more accurately from the sustainability goal. Therefore, Bossel (1999) proposes some requirements in developing indicators for sustainable development:

- Indicators of sustainable development are needed to guide policies and decisions at all levels of society
- These indicators must represent all important concerns: an ad hoc collection of indicators that just seem relevant is not adequate. A more systematic approach must look at the interaction of systems and their environment.
- The number of indicators should be as small as possible, but not smaller than necessary. That is, the indicator set must be comprehensive and compact, covering all relevant aspects
- The process of finding an indicator set must be participatory that the set encompasses the visions and values of the community or region for which it is developed.
- Indicators must be clearly defined, reproducible, unambiguous, understandable and practical. They must reflect the interests and views of different stakeholders.

- From a look at these indicators, it must be possible to deduce the viability and sustainability of current developments, and to compare with alternative development paths
- A framework, a process and criteria for finding an adequate set of indicators of sustainable development are needed.

In addition, CEC (1999) also gives general sequence procedure in selecting appropriate indictors of sustainable development:

- An indicator should capture the essence of the problem and have a clear and accepted normative interpretation.
- An indicator should robust and statistically validated
- An indicator should be responsive to policy interpretations but not subject to manipulation
- An indicator should be measurable
- An indicator should b e timely susceptible for revision
- the measurement of indicators should not impose on Member states, on enterprises, nor on the Union's citizens a burden disproportionate to its benefits

The general framework in developing indicators for sustainable development has been discussed above. The application of those general ideas about sustainable development indicators in watershed management context will be discussed below.

3.3 Sustainability Indicators in Watershed Management

Defining criteria and indicators for sustainable watershed management is to bridge the gap between politician and scientists (Hoekstra, 1993). UNECE (____) indicates that indicators on water issue are used to simplify, quantify, and communicate and create order within data. They provide information in such a way that both policy makers and the public can understand and relate to it. Developing 'good' indicators is not an easy task, however, and involves collection, collation and systematization of data. The need for clarity and ease of understanding means that indicators often condense large volumes of data into brief overviews and reduce the complexities of the world into simple and unambiguous messages. The need for scientific validity, on the other hand, requires that indicators must simplify without distorting the underlying patterns or losing the vital connections and interdependencies that govern the real world. They must therefore also be transparent, testable and scientifically sound. The sustainable watershed management is also related to water governance.

UNDESA (____) describes water governance as the range of political, social, economic and administrative systems that are in place to develop and manage water resources and delivery water services at different levels of society. Water governance is concerned on how institutions rule and how regulations affect political action and the prospect of solving given societal problems, such as efficient and equitable allocation of water resources. Some criteria for effective water governance proposed by UNDESA (____) are:

- Participation: all citizens should have a choice directly or indirectly throughout the decision making process.

- Transparency: information should flow freely in society
- Equity: all groups in society should have the opportunities to improve their well being
- Effectiveness and efficiency: processes and institutions should produce results that meet needs while making the best use of resources
- Rule of law: legal frameworks should be fair and enforced impartially, especially laws on human rights
- Accountability: governments, private sector and civil society organizations should be accountable to the public or the interests they are representing
- Coherency: taking into account the increasing complexity of water resources issues, appropriate policies and actions must be coherent, consistent and easily understood
- Responsiveness: institutions and processes should serve all stakeholders and respond properly to changes in demand and preferences, or other new circumstances
- Integration: water governance should enhance and promote integrated and holistic approaches
- Ethical considerations: water governance has to be based on the ethical principles of the societies, in which it functions, for example by respecting traditional water rights.

Brooks and Eckman (2000) in their research after drawing some lessons from projects on watershed management in some countries suggest some indicators in the achievement of sustainable watershed management. *First*, interdisciplinary approaches to project design are needed that integrate the technical and human dimensions of watershed management, which requires an understanding of cultures and traditional land use practices. *Second*, socioeconomic research and participatory techniques need to be incorporated early in the conceptual design and planning stages of projects. The "*hybrid planning style*" (Moss, 2003) that use both top down and participatory approach is needed.

Third, other means of providing incentives should be considered before utilizing subsidies or cash for incentives. When projects rely on subsidies, negative externalities may occur. In addition, the difference cultural and economic between donor agencies and receptor countries result in unfit economic strategies. *Forth*, environmental and socioeconomic monitoring is needed throughout implementation and following project completion to assist in informed decision making. *Fifth*, scale and topography aspects should be considered in coping with upstream-downstream interactions and cumulative watershed effects. *Sixth*, institutional structures should be developed recognizing watershed boundaries in simple structure. *Finally*, regional training and networking programs at all levels should be promoted together with existing networks.

Bossel (1999) argues that the world as a system consists of many subsystems which have relations among others, and this relationship is essential for understanding in system view. Therefore, the identifying of essential relationships in a system is crucial including the aggregation and condensation process of available information, and if necessary searching for missing information for comprehensive

description of the system. The system approach in watershed management will be elaborated below.

Watershed System Approach

A system can be described as "anything that is composed of system elements connected in a characteristic system structure" (Bossel, 1999, p. 20). The configuration of the system elements can perform particular system functions in its system environment. The function can be described as serving a distinct system purpose. Watershed can be seen as an ecosystem which is included in the self-organizing systems category (Bossel, 1999) in which it changes its structure to adapt to changes in its environment. The watershed system can be seen in the **Figure**.**3.2.**

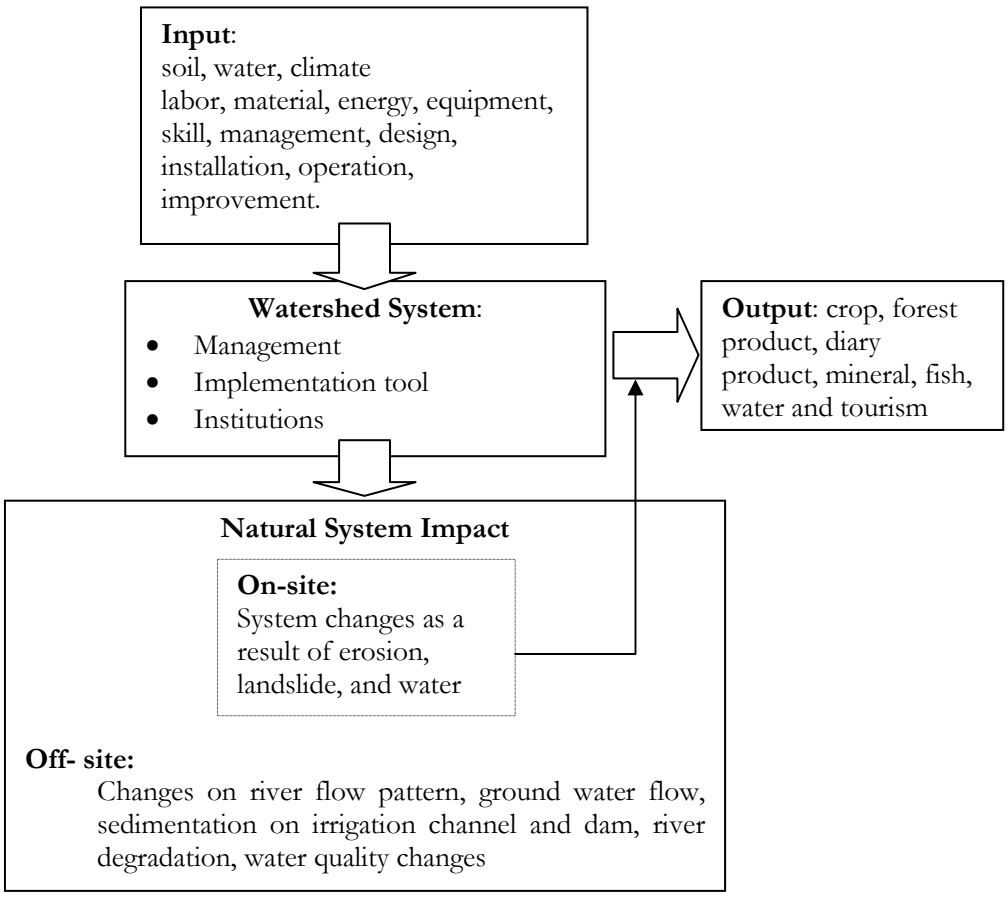

Figure 3.2 The Watershed System
Source: Adapted from Asdak (2002)

Systems can be complex based on the elements of structure of many different processes, subsystems, interconnections and interactions (Bossel, 1999). The individual systems not only assure their own viability but as a part of a complex system, they will contribute to certain function to the viability of total system. The efficient and effective interaction among subsystems will make viability of total

systems. There are two organizing principles in the evolution of a complex system: hierarchy and subsidiarity.

Hierarchical organization is a nesting of subsystems and responsibilities within total system in which each subsystem has its own autonomy for specific function to contribute to viability of the total system. Subsidiarity is related to the responsibility is given to each subsystem within its own abilities and potential. Bossel (1999) argues that only healthy and viable systems can develop sustainability. Thus, the healthy watershed can be seen as a way towards sustainable development.

*Sustainable Watershed Management Criteria and Indicators (**Legal**)*

From legal point of view, the Indonesian Ministry of Forestry has been developed criteria and indicators to assess the performance of a watershed by the decree No. 52/2001. The approach used in assessing the performance of a watershed is a system approach as described above. The good performance of a watershed results in a healthy watershed, which also reflects the sustainable watershed management. Some indicators will be selected to complement the sustainability indicators from CSD (2001) aforementioned. The criteria and indicators of watershed performance can be seen in **Table 3.2.**

Table 3.2 Criteria and Indicators in Assessing the Performance of Watershed

Criteria	Indicator	Parameter	Evaluation Standard	notes
A. Land Use	1. Land Cover	LCI = LVP / Watershed area x 100%	IPL > 75% good IPL = 30 - 75% medium IPL < 30% bad	LCI = Land Cover Index LVP = total area covered by permanent vegetation
	2. Land Suitability	LS = Suit land use / Watershed area x 100%	LS > 75% good LS = 40 - 75% medium LS < 40% bad	SLU: suitable land use
	3. Erosion Index	IE = Actual erosion / tolerable erosion x 100%	IE ≤ 1 good IE > 1 bad	Erosion calculation is based on the available data
	4. Land management	Plan pattern (C) and conservation technology (P)	C x P ≤ 0,10 good C x P = 0,10-0,50 medium C x P ≥ 0,50 bad	The calculation of C and P is based on the USLE guidance
B. Hydrology	1. river discharge	a. RRC = Q max / Q min	RRC < 50 good RRC = 50-120 medium RRC > 120 bad	Q = river discharge
		b. VC= ds / Q rate x 100%	VC< 10% good VC > 10% bad	VC = variant coefficient ds = deviation standard
		c. WUI = need / availability	The lower the value of WUI the better	WUI = Water Use Index
	2. Sedimentation	Sediment in water	The lower the sedimentation the better	Hydrological station
	3. water quality	Biological, chemical, and physical	Based on standard	PP 20/1990
	4 Sediment delivery ratio (SDR)	SDR = total sediment / total erosion	SDR < 50% normal SDR 50-75% abnormal SDR > 75% bad	Calculation based on the hydrological data from hydrological station
C. Social	1. Individual respect	E self conservation	Exist, or not	From relevant institution.
	2. participation	% of presence of people in water management activity	> 70% high 40-70% medium < 40% low	Data from related institution
	3. land pressure index	Land pressure index $LPI = z^* \frac{f\,Po\,(1+r)^t}{L}$	LPI < 1 low LPI = 1-2 medium LPI > 2 high	t = time in 5 years z = minimum of land area for surviving f = proportion of farmers to total population in the watershed Po = total population in year 0 L = agricultural area r = population growth
D. Economic	1. reliability on land	Contribution of agriculture to total household income	> 75% high 50-75% medium < 50% low	
	2. income level	Household income/year	Poverty line	
	3. land productivity	Production/ha/year	trend	
	4. environmental value	Internalize the externalities (cost sharing)	Exist, or not	Allocation of budget on environment
E. Institution	1. empowerment of local people	The role of local institution in watershed management	Play role, or not	
	2. reliability of people to government	Government intervention	High, medium, low	
	3. collective entrepreneur activity	Amount of entrepreneurs	Trend	

Source: Adopted from Indonesian Ministry of Forestry decree No. 52/2001

These criteria and indicators in general are good and already divided into dimensions from sustainable development: environment (land use and hydrology), social, economic and institution. The standards in some indicators have also been developed based on the scientific validity and international agreement. Nevertheless, some indicators have a lack of standard and need a good interpretation from the decision makers to decide whether it is bad or good, for example in economic and institutional criteria. Therefore, the expertise of decision makers in assessing the performance is important.

This research will not develop the standard of as the weaknesses of some criteria described above, but will give elaboration on some criteria and indicators which are not standardized. The criteria and indicators selected for this research are described below.

3.4 Criteria and Indicators (C&I) selected

Based on the elaboration of criteria and indicators of sustainable development above in which some characteristics of indicators have been described, thus the criteria and indicators needed for assessing the sustainability application in Serayu watershed are described below (**actual**). The selection of the indicators is based on the availability of data for the analysis and also these indicators can minimum requirements toward sustainable watershed management. The application of all indicators will give better understanding of the process in the case study, but the limitation exist should not impede the assessment. The criteria are defined as the dimensions of the sustainability: environment, social, economic and institutional.

Environmental Criterion

- Budget allocation of environment

This indicator is related to the concern of government in environment. The more the percentage of the budget allocation on environment, the better the concern of government on environment. Due to the high concern of each local government in economic development after decentralization era, this indicator is very important illustrating the willingness of each local government to address the environmental issues. Besides, because the impact of a good environmental condition is not felt directly at present, it is a challenge of local government to allocate sum of budget in environment.

- Agriculture: arable and permanent crop land area

This research will use this indicator because the arable and permanent crop land area in the watershed can ensure the food security in the area. Thus, it is very important. Besides, the sustainable practice of agriculture can contribute to conservation particularly in rural area, which is commonly dominated by agricultural area. The availability of data needed for the assessment also become consideration in selecting the indicator. The use of fertilizer and pesticides are also important as indicators of sustainability, but again, the availability of data in the case study is becoming a limitation.

Even though it is not mentioned in the legal C&I for watershed performance defined in sub chapter 3.3, but the ideal C&I mentioned in sub chapter 3.2 proposed

this indicator. Other reasons why this indicator is important is described by CSD (2001) below.

CSD (2001) defines land is an area not only of physical space and surface topography, but also all related natural resources such as soil, mineral, water, plant and animal communities. The unsustainable use of land can influence these resources. Recently, land is becoming rare resources, especially for primary production (agriculture) and for conservation because of the extension use of human requirements. The level of changes of land use land covers can threaten the stability and resilience of ecosystems through global warming and disruption of the global nitrogen. CSD (2001) argues that agricultural area plays an important role in the context of sustainable land use because it is needed to increase the production of food and to improve its function in land resource. Moreover, agriculture can support the socio-economic development and the maintenance of rural lifestyle. If agriculture is practiced in a sustainable manner, thus it will contribute to the conservation of rural area and other related natural resources.

- Forest: Forest area as a percent of land area

The percentage of forest in an area is mainly related to hydrological aspect. The optimal forest area can guarantee the forest function as streamflow regulator that is very important in an area. Besides, the existence of forest can contribute to carbon sequestration and micro climate. The forest can absorb CO_2 then produce O_2 that is very important for humans and animals. Forest also has social and economic function. This research will use this indicator because of the reasons aforementioned and also the availability of data in the watershed.

- Fresh water: Water Quantity and Quality

Freshwater is very important to support human life, ecosystems, and economic development (CSD, 2001). It is related to domestic water supplies, food production, fisheries, industry, hydropower generation, navigation and recreation. The ecosystem can give services in freshwater systems such as food production, reduction of flood risk, and filtering air pollutants. Water resource and its management are closely related to other global issues such as health, poverty, climate change, deforestation, desertification, and land use change.

Social Criterion

- Poverty : Percent of Population Living Below the Poverty Line

CSD (2001) states that social equity is one of the principal values underlying sustainable development, with people and their quality of life are recognized as a central issue. Equity is related to fairness and inclusiveness of resources distributed, opportunities afforded, and decisions made. Essential issues related to the achievement of social equity are poverty alleviation, employment and income distribution, gender, access to financial and natural resources and intergenerational opportunity. Poor people may feel powerless and isolated, pervasive and systematic problems related to insecure livelihoods, malnutrition and poor health, illiteracy, civil insecurity and corruption. The concentration of the poor in the marginal land in the rural area can cause the resource over exploitation and land degradation.

- Education level:

CSD (2001) indicates that one of the prerequisites of sustainable development achievement is education because education can improve people in meeting basic human needs, capacity building, access to information, and strengthening science. Moreover, education is also recognized as a means of changing consumption and production patterns to a more sustainable path. Education is aimed at optimizing potential human beings and societies to achieve ethical awareness, values, attitudes, skills and behavior in line with the goal of building more sustainable society. Therefore, people can participate better in decision making process that adequately and successfully addresses environment and development issues.

- Population Growth Rate

CSD (2001) notices that population is important in providing contextual reference on sustainable development for decision makers in looking at the interrelationships between people, resources, the environment and development. Population change can also become valuable information in developing programs on reducing poverty, economic strategy, environmental protection, and move towards sustainable consumption and production. CSD (2001) points out that the more stable of fertility can have a considerable positive impact on quality of life. But, the rapid urbanization growth and migration can stimulate to unsustainable living conditions and increased pressure on environment, particularly in ecologically-sensitive area.

Economic Criterion

- Economic Performance: GDP per capita and economic structure of a region

GDP is similar to the more familiar Gross National Product (GNP) except that it does not include profits sent to or received from abroad (Hall, 2000). GDP per capita is a standard measure of basic economic growth (CSD, 2001). Investment share in GDP indicates the level of financial capital available to trigger economic development.

CSD (2001) indicates that trade and investment are determinants in economic growth and sustainable development. The critical to assisting developing countries meet the objectives of sustainable development are improved access to markets, transfer of financial resources and technology, and debt relief. Economic growth is closely related to poverty, natural resource exploitation, and consumption and production. It is our challenge to ensure that economic growth will lead to social equity and will give less contribution to environmental degradation.

This research will use this indicator due to the availability of data and even though this indicator has some weaknesses, for example it does not internalize the economic value and does not show the distribution of wealth for humans, it shows in general the humans' welfare.

Institutional Criterion

- Strategic Implementation of Sustainable Development: National Sustainable Development Strategy and other Related Policies

The main reason why select this indicator is because the existence of national development strategy can harmonize the various sectoral economic, social and

environmental policies and plans to ensure socially responsible economic development while protecting the resource base for the benefit of future generations. In watershed management context, the strategic level of sustainable watershed management is stated in the policies related to it referring to the national strategy on sustainable development. Therefore, this research also briefly describes the related policies to sustainable watershed management as an indication of sustainability concept to be applied in the watershed.

- Clear Role of Actors Involved

As elaborated in Chapter 2, the good watershed institution can facilitate not only the achievement of social and economic goals, but also environmental goals. The institutional setting for effective and efficient management of a system is characterized by: clear rules, practices and organizations providing to human actions related to water management (Bandaragoda, 2000). As also successful in the US, the clear role of actors involved in the decision making as described in Chapter 2 is the reason of the indicator selected.

- Agreement Among Actors

Due to the many actors involved in the decision making process, the agreement among actors is important to achieve goals. The agreement among actors indicates the good interaction among actors which is called "social capital" or "institutional capacity" (Healey, 1999, p. 61). The good interaction among actors indicates the sustainability in institutional dimension.

3.5 Concluding Remarks

Sustainability assessment is a term used for the assessment of whether sustainability concept is applied in the programs, plans, and policies. It is originally come from Environmental and Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) activities (Pope et al, 2004). The approach used in this research is top down approach, which defines the sustainability criteria based on state of sustainability. Sustainability assessment also refers to evaluation consisting of ex ante, mid term, and ex post (Roberts, 2006). This research uses the ex ante method that evaluates the Serayu watershed master plan made by the EACJP before it is applied.

The criteria and indicators (C&I) of sustainable development are tools in sustainability assessment. The ideal C&I have been developed by the Commission of Sustainable Development (CSD) in 2001 through workshop followed by many countries supported by scientific argumentations. These C&I can be used as general tools developed for assessing the sustainability of projects, programs, and plans, including watershed management plan. There are four main themes in this ideal C&I: environmental, social, economic and institutional. Moreover, the government of Indonesia through Minsitry of Forestry has also developed C&I for watershed performance using the ecosystem approach. The health condition of a watershed is assumed to be a sustainable watershed. This C&I can be seen as legal C&I.

From the C&I described in the ideal and legal point of view, some criteria and indicators used for this research are selected. The criteria are similar to the dimensions of sustainability itself: environment, social, economic and institutional. In environmental criterion, the indicators selected are budget allocation of environment,

agricultural and forest area, and fresh water quantity and quality. The indicators for social criterion are poverty, education level, and population growth. Economic performance indicated by GDP per capita, economic structure of a region and economic growth determines the economic criterion. The existence of national strategy of sustainable development is an indicator in institutional criterion. The way institution design is also an indication of the effective and efficient management that also become indications of sustainability. The agreement among actors involved in the decision making shows the good relationship among actors which indicates sustainability in institutional perspective.

Chapter 4 Characteristics of Serayu Watershed

The previous chapters have described the theoretical framework developed for the sustainability assessment. The criteria and indicators have also been selected. This chapter describes the characteristics of the case study. The illustration of water management in Indonesia is described briefly to give more understanding of water management in Indonesian context. The biophysical condition depicts the description of location, hydrological condition, soil condition, and land use. Socio economic condition of the case study indicated by population and welfare (poverty) is also drawn. At the end of this chapter, the description of the environmental problems in the case study illuminates the illustration of the case study.

4.1 Water Management in Indonesia

The history of water management in Indonesia is described briefly to give more understanding of Indonesian context of water management. There are three periods of water management can be distinguished in Indonesia that are mostly influenced by external factor. For example, Dutch colonial water regulation was still used after Indonesia got his independence in the first period. Global economic conditions has forced Indonesia to become a borrower from multinational agencies and adopted many concepts in the second period. Again, multilateral agencies play an important role in the reform era that influenced much on the policy making including water sector.

The Development Decades: 1960's – 1980's

Houterman et al (2004) in his work sees that in this era much of water resources development was a private or community affair – at times triggered by local leaders or religious institutions. For example, in central Java nearly 45% of the irrigated area is served by village or simple system, most of them with history of local management. For a long time, Dutch colonial regulation 1936 was still the guidance in water resource management. In 1969, the government of Indonesia released the laws and regulations related to water influencing water resource development directly or indirectly. In pre-1969 period, the main focuses of water resource development are irrigation, river improvement, urban drainage, agriculture, housing and settlement, water quality, management of rivers, flood control, and drought prevention. The large scale transmigration was begun in this period.

Shift to System Management: 1980's – 1990's

Houterman et al (2004) indicates the next era of water resource management in Indonesia as a shift to system management beginning in 1987 as the first year of government effort in shifting from "*development*" to "*management of water systems*" – particularly in irrigation sector and watershed management. There was a policy shift in Indonesia due to the downswing in the oil market and its impact on Indonesia's revenue. Indonesia began to become a borrower from multilateral banks and bilateral agencies (especially Japan). Participatory management became a new paradigm in

irrigation management. Philippines practice was one of the best practices in applying irrigation system.

Water Sector Reform – Beyond 1998

Houterman et al (2004) illustrates that in this era, there were larger institutional changes which had important impact on the management of water resources and drainage systems. The fall of Suharto regime is the beginning of the reform era which implicates in some aspects such as local government and community empowerment, government transparency, and democracy. Issues like decentralization and regional autonomy became central issue in this era due to the discrepancies of development and welfare in the previous era.

Because Indonesia is one of the World Bank borrowers, the "*policy transfer*" as described by Dolowitz and Marsh (1996, p. 348) as "*indirect coercive*" in water management policy is conducted. Water Resources Sector Adjustment Loan (WATSAL) promoted by World Bank stimulates the water reform in Indonesia. The all-powerful Ministry of Public Works was changed into Ministry of Settlements and Regional Development (Kimpraswil). The Directorate General of Water Resources is responsible for the water resources development. Ground water is managed by Ministry of Mines and Energy. Agency for Environmental Impact Management (Bappedal) is responsible for setting environmental quality standards. The Ministry of Forestry is responsible for watershed protection.

Watershed Management in Indonesia

Indonesia is one of the frontrunners in watershed management (Houterman et al, 2004). In the early of 1980 the concept of "one river, one plan one management" was adopted as policy. 90 rivers basin units (SWS) were identified to reinforce planning, development, and management of water resource by the Decree of the Minister of Public Works No. 48/PRT/1990. There are two major river basin adopted best practice from other countries: Brantas River Basin in East Java adopted French river organization model and Jatiluhur authority adopted Tennessee Valley Authority model.

4.2 Location description

The Serayu watershed is located within the province of Central Java in Indonesia in coordinate of 07° 05'-07 °4' south latitude and 108 ° 56'-110 ° 05' east longitude.. It has an area of approximately 3.368 km^2 encompassing 5 regencies: Wonosobo, Banjarnegara, Purbalingga, Banyumas, and Cilacap. The watershed is bounded by mountain Slamet (3,420 meter asl) in the north in series of hill to the east in Banyumas and Purbalingga regency, and mountain Sumbing (3,246 meter asl) and Sindoro (3,136 meter asl) in the east in Wonosobo regency. In the south it is bounded by the South Serayu uplands.

Figure 4.1 Serayu Watershed
Source: Department of Irrigation and Drainage (2006)

4.3 Biophysics Characteristics

Rainfall

The average annual rainfall in Serayu watershed varies from 1,821 mm/year in Klampok (Purbalingga) up to 4,477 mm/year in Pringombo (Wonosobo). Based on the average amount of wet and dry months in a year (Oldeman climate classification), the watershed is divided into 2 types: B (characterized by 7-9 wet months) and C (characterized by 5-6 wet months). Based on the calculation of Thornwaite climate classification which is based on the drought index, the index is between 0 – 3.55% showing that there is no potential drought in Serayu watershed. Moreover, the humidity index of the watershed is between 50-500% indicating water surpluses in the watershed.

Soil

Based on Mangunsukardjo soil classification, Serayu watershed consists of several type of soil: alluvial, regosol, litosol, andosol, latosol, grumusol, and podzolik. Alluvial soil is spread in the old and ageless terrain. In the old alluvial terrain, it changed into grumusol and in the ageless alluvial terrain it can be seen as different sedimentation level in different period. There are 3 types of alluvial soil in the watershed: hydromorfic, yellow grey, and brown grey alluvial. The most suitable land use for this type of soil is paddy field.

Regosol soil type as well as alluvial is still ageless soil. In general, regosol soil is derived from sedimentary rock and due to the intensive geomorphologic process,

the soil formation process is impeded. Regosol soil in the watershed is developed in coastal area and in conical area of mountain Slamet, Sindoro, and Sumbing. Apparently, regosol soil type in the coastal area is not productive soil because of its high porosity. In contrast, regosol soil in the mountain is productive soil because of its relatively high water and mineral availability. The addition of organic fertilizer can enhance regosol soil productivity.

Litosol soil is a thick soil with < 50 cm depth and it is directly contacting to the rock. Litosol soil is derived from hard rock, thus it has limitation in its formation. But, litosol can also be formed in the area which has intensive erosion. The potency of litosol soil is very limited, thus it is recommended to be used as non agricultural areas. Infiltration capacity of litosol soil is very limited thus it becomes an important factor in determining flood risk area. This type of soil is in trend increasing due to the unfit land use. The treatment of using this type of soil so that it can increase its economic value is by mining the rock under it.

Andosols is derived from mountain dust. The color of this soil is deep black as a result of imperfect spoil process of dust mountain rock. It is due to the low temperature and high rate rainfall in a year. Based on this condition, andosols are only located in the mountain area having elevation > 900 meter. Andosol has specific characteristic as dusty and low density soil. Hence, it is easily eroded. The unwise usage of this type of soil can cause litosol formation which has low productivity.

Latosol is a soil type developed due to the influence of wet climate making the deep profile of soil. Latosol is derived from volcanic rock located in the relief having good drainage condition. Latosol is produced by percolation water transporting soft material from soil surface to undersurface soil. Latosol is very potential in agricultural usage, but it is easily to be eroded because its location is in steep land. Because its good infiltration capacity, latosol can guarantee the water availability in the down hill steadily in years.

Grumusol is a clay soil which has flexibility in expand and shrink as a result of *smectite* clay. This clay is specifically formed in tropical area. Grumusol can be derived from many kind of rocks which has abundant clay (>35%) and under condition in which Calcium is dominant in cation changing. Grumusol is potential for agricultural area if water is available appropriately. In dry season this type of soil becomes crack. The location of this soil is spread in downstream of river Klawing, Pekacangan and Merawu.

Podzolik is type of soil which has developed for long time (old soil) remaining a little part of ferrum coloring red yellow. Podzolik developed as a result of sandy rock. The mustiness of sandy rock will only remain silica and alumina and little amount of ferrum. This type of soil is less productive because it is poor of mineral and very porous, so it can not retain water. It also has a high risk of erosion due to its high portion of clay and small portion of organic matter. The soil aggregate is easily broken in the rain.

Flood Prone Area

Serayu River has its upstream in Dieng hill and has several tributaries: Begaluh, Tulis, Merawu, Klawing, Banjaran, Sapi and Tajum. The main river flows from Dieng to the south via Laksono, Sudirman dam, Wanadadi, Mandinaga, Purworejo till Banyumas and ended in Hindia Ocean in Cilacap.

Flood prone area in Serayu watershed is caused by the over capacity of water in the river in high rainfall and by bad drainage condition. There are several factors in determining flood occurrence:

- Meteorological factor, for example rainfall
- Hydrological factors, factors that influence effective rainfall or run off coefficient, such as slope, vegetation, infiltration, soil surface depression and river channel. Watershed which has run off coefficient > 70% indicates high risk of flooding.
- Morphometry such as the wide of the watershed, slope of main river, length of main river, river slope, watershed form will influence the time concentration of river flow. The less the time concentration the more risky of flood occurrence.
- Humans, manifested in the disturbance on flood reducer building and unfit of land use

Hydrology

The irrigation system in Serayu watershed has been intensively developed, for example the establishment of some water pump stations in some places such as: Singomerto, Banjar Cahnyana, Panaruban, Tajum, Gambarsari, and Pasanggrahan. Besides, some impermanent and traditional water stations have been established in some places, such as Serayu Hulu, Merawu, Tulis, Urang, Pekacangan, Gintung, Klawing, Banjaran, Logawa, Sapi, Tajum, etc.

Discharge rate, maximum discharge and minimum discharge from 1991 – 2002, are indications in depicting hydrological condition in Serayu watershed. Kunkle (1976) noticed that discharge evaluation should use specific discharge reducing the watershed wide factor so that the discharge unit is in $m^3/sec/km^2$. The specific discharge in Serayu watershed is shown it **Table 4.1**.

Table 4.1 Specific discharge in rivers in Serayu watershed

No	River	Vide (km^2)	reme Discharge ($m^3/sec/km^2$)	scharge rate ($m^3/sec/km^2$)	Q min ($m^3/sec/km^2$)	Q max ($m^3/sec/km^2$)
1	Begaluh (Krasak)	233.10	0.656	0.084	0.026	25.2
2	Merawu (Cilangap)	276.20	0.765	0.052	0.007	109.0
3	Klawing (Sliga)	581.00	581.000	0.121	0.021	71.4
4	Klawing (Dagang)	31.30	31.300	0.136	0.033	38.4
5	Serayu (Bj.negara)	723.30	0.979	0.079	0.007	139.9
6	Banjaran (Kober)	44.50	4.073	0.107	0.002	2,036.5
7	Tajum (Tiparkidul)	247.50	1.873	0.080	0.012	156.1
8	Serayu (Banyumas)	2,631.30	0.577	0.093	0.023	25.1
9	Serayu (Rawalo)	3,096.00	0.489	0.089	0.027	18.1

Source: BCEOM (2000) in EACJP (2003)

Table 4.2. Criteria on specific discharge

CRITERION	Q MAX (M^3/SEC/ KM^2)	Q MIN (M^3/SEC/ KM^2)	DISCHARGE RATE (M^3/SEC/KM^2)	RATIO Q MAX/Q MIN
BAD	>1.5	<0.015	<0.035	>100.0
GOOD	1.00	0.018	0.040	<55.6
VERY GOOD	<0.87	>0.020	0.047	<43.5

Source: Kunkle (1979) in EACJP (2003)

Extreme discharge is peak discharge or minimum discharge. From Table above, minimum specific discharge is bad (>0.035 $m^3/sec/km^2$). This is because the usage of water in the dry season is very intensive causing the level of discharge. From the Table, it is clearly seen that the ratio of Qmax/Qmin is included in bad category for Merawu, Klawing, Tajum, and Banjaran rivers.

Water quality in Serayu watershed is affected by: contamination of organic matter from traditional market and households along the river, industrial disposal such as sugar industry, tapioca industry, textile industry, milk industry, tofu and sauce industry, agricultural disposal, such as fertilizer and pesticide, and erosion and landslide

According to BCEOM (2000) in EACJP (2003), Serayu river is contaminated by cities along the river such as: Banyumas, Banjarnegara, Wonosobo, Ajibarang, Purwokerto, Sokaraja, and Purbalingga. Other pollutant comes from tobacco, potato, corn, etc. agricultural area in the upper watershed causing agricultural disposal. In general, water quality in Serayu watershed is low and inappropriate for domestic consumption.

Table 4.3 Water quality in 13 point samples in Serayu watershed

No	Point sample (River)	Variable more than Quality Standard (Class I & II)	Quality Standard (Class I & II)	Pollutant source
1	Serayu Hulu Madukara, Banjarnegara	**Dry season** BOD (1,701 - 4,764 ppm) COD (19,21 - 33,33 ppm) DO (7,07 - 8,95 ppm) Phenol (0,001 - 0,0431 ppm) **Rainy season** BOD, COD, DO Phenol, (Total Suspended Suspension) TSS (294 ppm)	 2 - 3 ppm 10 - 25 ppm 0,001 ppm 50 ppm	Agricultural Households Sedimentation Siltation
2	Serayu Tengah Kaliori, Banyumas	**Dry Season** BOD (1,729 - 8,494 ppm) COD (9,19 - 34,06 ppm) DO (5,90 - 6,86 ppm) Phenol (0,004 - 0,280 ppm) **Rainy Season** BOD, COD, DO Phenol, (Total Suspended Suspension) TSS (205 ppm)	 2 - 3 ppm 10 - 25 ppm 0,001 ppm 50 ppm	Agricultural Households Sedimentation Siltation
3	Serayu Hilir Kebasen, Banyumas	**Dry Season** BOD (2,964 - 12,590 ppm) COD (17,54 - 46,38 ppm) DO (4,13 - 7,03 ppm) **Rainy Season** BOD, COD, DO Phenol, (Total Suspended Suspension) TSS (304 ppm)	 2 - 3 ppm 10 - 25 ppm 50 ppm	Agricultural Households Sedimentation Siltation
4	Begaluh Selomerto, Wonosobo	**Dry Season** BOD (3,485 ppm) COD (24,34 - 39,86 ppm) DO (6,433 - 8,410 ppm) TSS (52 ppm) **Rainy Season** BOD, COD, DO, Phenol and TSS has fulfilled class II standard	 2 - 3 ppm 10 - 25 ppm 50 ppm	Agricultural Households Sedimentation Siltation
5	Merawu	**Dry Season** PO4 (0,808 ppm) Phenol (0,036 - 0,09 ppm) **Rainy Season** BOD (6,401 pp) COD (63,460 ppm) PO4 (0,215 ppm) Phenol (0,042 ppm)	 0,2 ppm 0,001 ppm 2 - 3 ppm 10 - 25 ppm 0,2 ppm 0,001 ppm	Agricultural Households Sedimentation Siltation
6	Pekacangan Krenceng Dam Bukateja, Purbalingga	**Dry Season** BOD (4,055 - 33,480 ppm) COD (28,40 - 96,65 ppm) DO (1,840 ppm) Phenol (0,138 ppm) TSS (17 - 34 ppm) **Rainy Season** BOD, COD, DO Phenol, (Total Suspended Suspension) TSS (564 ppm)	 2 - 3 ppm 10 - 25 ppm 0,001 ppm 50 ppm	Agricultural Households Sedimentation Siltation

No	Point sample (River)	Variable more than Quality Standard (Class I & II)	Quality Standard (Class I & II)	Pollutant source
7	Klawing Kaligondang Purbalingga	**Dry Season** BOD (2,063 - 4,815 ppm) COD (10,86 - 26,37 ppm) DO (6,04 - 8,83 ppm) Phenol (0,004 - 0,035 ppm) TSS (11 - 38 ppm) **Rainy Season** BOD, COD, DO Phenol, (Total Suspended Suspension) TSS (300 ppm)	 2 - 3 ppm 10 - 25 ppm 0,001 ppm 50 ppm	Agricultural Households Sedimentation Siltation
8	Banjaran Banjaran Dam Purwokerto (upper) Purwokerto- Ajibarang Bridge(downstream)	**Dry Season** BOD (3,050 - 6,572 ppm) COD (28,260 ppm) Phenol (0,007 - 0,106 ppm) TSS (8 - 46 ppm) **Rainy Season** BOD, COD, DO Phenol, (Total Suspended Suspension) TSS (126 - 224 ppm)	 2 - 3 ppm 10 - 25 ppm 0,001 ppm 50 ppm 50 ppm	Agricultural Households Sedimentation Siltation
9	Tajum Tipar Kidul, Ajibarang	**Dry Season** BOD (1,748 - 5,410 ppm) COD (11,70 - 37,53 ppm) Phenol (0,004 - 0,118 ppm) TSS (10 - 38 ppm) **Rainy Season** BOD, COD, DO Phenol, TSS (730 ppm)	 2 - 3 ppm 10 - 25 ppm 0,001 ppm 50 ppm 50 ppm	Agricultural Households Sedimentation Siltation
10	Sapi	**Dry Season** BOD (3,230 - 4,562 ppm) COD (10,86 - 40,56 ppm) Phenol (0,004 - 0,062 ppm) DO (6,430 - 8,410 ppm) **Rainy Season** TSS (564 ppm)	 2 - 3 ppm 10 - 25 ppm 0,001 ppm 50 ppm	Agricultural Households Tapioca industry Sedimentation Siltation

Source: BCEOM (2000) in EACJP (2003)

From **Table 4.3** above, it is clearly seen that downstream areas suffer worse water quality than in the upstream. The increasing value of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), and usually followed by the lowering value of DO indicates the organic pollution in the water. It will influence the water biota such as fish. The value of DO in all point samples is still above the standard of class II. It indicates that self purification power of Serayu watershed is still in good condition. The increasing value of BOD, COD and phenol is dominantly caused by agricultural activities, households, and tapioca industry. Moreover, total suspended suspension is caused by the high discharge of water caused by heavy rainfall eroding soil in the hilly slope.

Sudarmadji (1997) defines domestic waste has medium power if suspended suspension is 720 mg/l, fat 100 mg/l and Chloride 50 mg/l and weak power if suspended suspension is 350 mg/l, fat 50 mg/l and Chloride 30 mg/l, 60%-80% of total amount of water used by humans will be disposed to the nature. Total amount of domestic waste is influenced by total population and water needs. EACJP (2003)

calculate that total domestic waste in Serayu watershed is dominated by cities Purwokerto, Purbalingga, and Wonosobo, and also sub district Sukoharjo, Kembaran, Kutasari and Kalimanah. Purwokerto, for example, produces 559 ton/year with suspended suspension 3,976 ton/year.

The water utilization in Serayu watershed is dominated by irrigation for agricultural area, households, and drinking water. In Wonosobo regency, water is used for irrigation and fishery. In Banjarnegara, water is used mainly used for hydroelectric power (Jendral Soedirman dam), fishery and irrigation. In downstream area, such as Banyumas and Purbalingga, water is mostly used for agricultural purposes. In Cilacap, water is also used for drinking water.

Land Use

The percentage of forest in Serayu watershed is 19.14% and water body 0.22%. These land uses has positive role in the watershed. In contrast, the land uses with negative role in the watershed such as bushes, residential areas, cities, and dry lands are 29.9% of total watershed. The land use in Serayu watershed can be seen in Figure and Table.

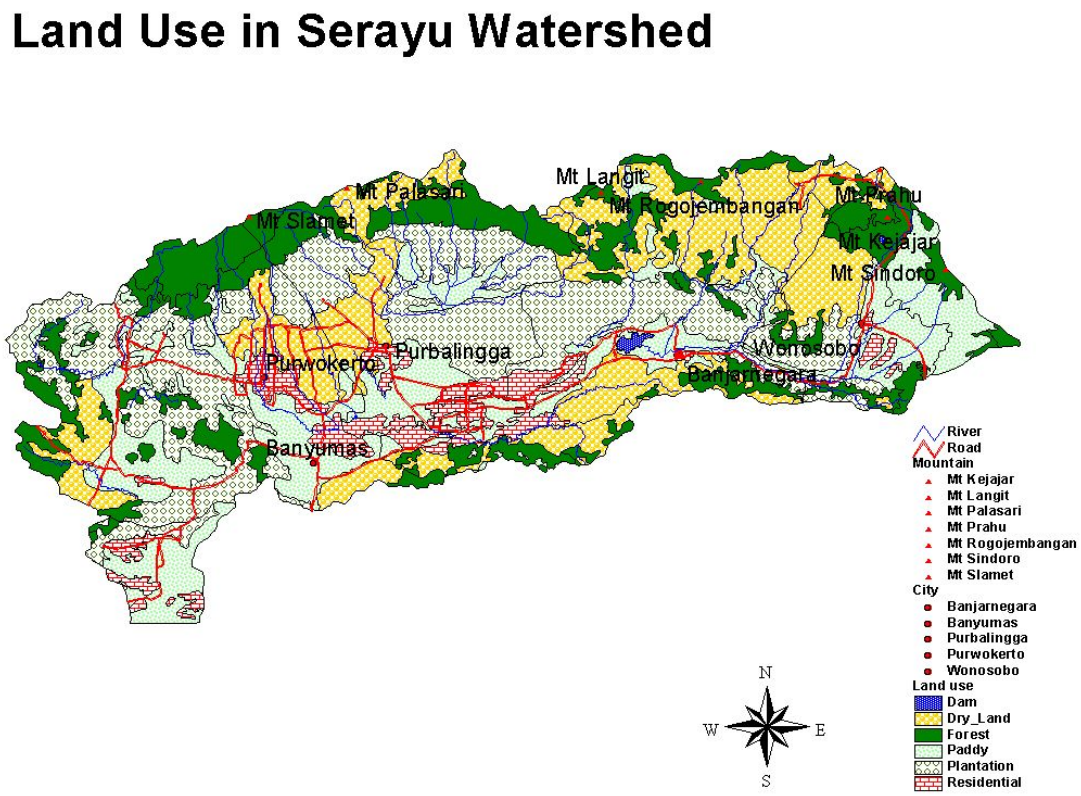

Figure 4.2 Land use in Serayu watershed

Table 4.4 Land use in Serayu watershed (in Ha)

	Wonosobo	Banjarnegara	Purbalingga	Banyumas	Purwokerto	Cilacap
Water body	89.6	717.9		6.0		
Forest	12252.7	18985.0	14344.0	24447.8		495.4
City	223.2	317.5	714.0	900.6	768.5	
Plantation	9009.0	29667.4	31600.7	33095.0	43.1	
Residential Area				419870.0	663.9	2788.9
Paddy field	9430.0	14377.2	4062.2	25849.7	582.7	8489.7
Dry land	20414.6	46864.6	13044.8	23763.4		2902.9

Source: modified from EACJP (2003)

Biophysics Problems

Based on the biophysical characteristics mentioned above, there are several problems identified. These biophysical problems can be nature caused or human caused. The biophysical problems in Serayu watershed are:

1. Air and Climate; The air and climate problems are mainly caused by the growing population in the area influencing the more transportation and less green area.

2. Water Resource; Water resource problems identified in the watershed are: drought (as a result of the imbalance of rainfall and evapotranspiration capacity), water pollution (mainly in downstream, but polluted water also exist in the upper as a result of intensive agriculture), flood mainly in downstream, sedimentation (mainly in the dam caused by high soil erosion in the upper), intrusion (in the estuary).

4.4 Economic characteristics

Socio economic indicators used in the river basin management plan is education level, wealthy and poverty. It is assumed that the higher the level of education the higher concern of environment. It is also assumed that the middle-high education people can absorb information given by many institutions related to environment. For low educated people, it is assumed that they have low concern on environment. In average, 90.69% residents in Serayu watershed are still in low education. The highest proportion of low education residents is 98.13% in Pegaten sub district, Banjarnegara regency. In contrast, in Purwokerto Utara sub district there is 59.73% of total population which has low education. It is caused by the existing university in Purwokerto Utara sub district.

The other aspect of social economic aspect is wealthy. One indicator to determine the wealthy level is poverty level. It is calculated by ratio of total poor households and total households in an area. It is assumed that the wealthier the area, the more concern of environment people has. It is because poor household will use every resource they can get to fulfill their basic needs without considering environmental issue. From National Family Planning Agency (BKKBN) data, the poverty rate in Serayu watershed is 39.18%. The highest poverty level is in Karangreja sub district, Purbalingga regency (63.42%), and the lowest level is in

Watumalang sub district, in Wonosobo (10.89%). Based on the two aspects above, it can be classified into four categories:

- Low poverty level and low population growth is assumed as an area with high carrying capacity but the people is not potential
- Low poverty level and high population growth is assumed as an area with high carrying capacity and the people is highly potential
- High poverty level and low population growth is assumed as an area with low carrying capacity and the people is not potential
- High poverty level and high population growth is assumed as an area with low carrying capacity and the people is highly potential

Table 4.5 Poverty level and population growth in Serayu waterhed

		Population Growth	
		Low	**High**
Poverty Level	**Low**	Kesugihan, Madukara, Lumbir, Banjarmangu, Jatilawang, Kalibening, Rawalo, Preng, Pekuncen, Selomerto, Purwokerto Barat, Kalikajar, Purwokerto Timur, Kretek, Purbalingga, Watumalang, Bojongsari, Garung, dan Banjarnegara	Maos, Kalimanah, Adipala, Karangkobar, Patikraja, Batur, Kembaran, Wonosobo, Sokaraja, Kejajar, Purwokerto Selatan, dan Purwokerto Utara
	High	Jeruklegi, Kemangkon, Wangon, Kejobong, Kebasen, Kaligondang, Banyumas, Padamara, Purwojati, Mrebet, Ajibarang, Karangmoncol, Gumelar, Rembang, Kedung- banteng, Bawang, Baturraden, Wanadadi, Punggelan, dan Purwonegoro	Somagede, Susukan, Cilongok, Purwokerto Klampok, Karanglawas, Mandiraja, Sumbang, Sigaluh, Bukateja, Rakit, Pengadegan, Pagentan, Kutasari, Pejawaran, Bobotsari, Wanayasa, Karangrejo, Mojotengah, dan Karanganyar

Source: EACJP (2003)

Economic Problems

The socio-economic problems identified in the watershed are: the increase of population growth, land pressure, unemployment, low level of education and wealth, low participation of the citizen in the decision making process. The fast growing of population in the upper watershed increases the need of the people on the natural resources such as forest and land causing the land degradation. On the other hand, the fast growing population in the downstream such as urbanization causing the high usage of the land, for example residential area, industry, etc. The high unemployment rate in the watershed caused by the low job opportunities in non agricultural sector exaggerates the land problems because it will increase the man reliability on agriculture sector. Moreover, the poverty problem occurred in the watershed is identified as one factor in environmental degradation. The low level of education, Javanese culture and top down bureaucracy in the past cause the low level of participation of the people in the decision making process particularly on environmental issues

4.5 Social Characteristics

Population

There are two important aspects of population related to watershed: population growth and population density. These aspects are important in predicting social economic condition in the future. Population growth needs to be considered in planning of social facilities and job opportunities. The average population growth in Serayu watershed from 1999 – 2000 is 0.97% (EACJP, 2003). In general this growth is relatively low, but there are sub districts with high population growth: Mojotengah in Wonosobo regency (4.15%).

In 2000, population density of Serayu watershed is 15 person/ha. The most densely populated area is in Purwokerto because there is a university attracting people to come. Purwokerto is also relatively growing faster than other area. The lowest population density is in Karangreja sub district, Purbalingga regency.

The relationship between population and environment can be described below:

- Low population growth and low population density is assumed placing in the area with low carrying capacity; this area can not be developed without support from the government program
- Low population growth and high population density is assumed as an area which has developed for long time, so it has already saturated.
- High population growth and low population density is an area with a high carrying capacity and well developed. This area is usually be able to develop without relying only on government support.

According to EACJP (2003), sub districts in Serayu watershed are generally low in population growth and population density (33 sub districts). These sub districts are clustered in the upper watershed or in the southern part of Banyumas regency and in the middle of Banjarnegara. These areas are not really risky for the environment.

4.6 Ecosystem

There are several ecosystems in the basin which have different problems and need to be handled specifically. Some ecosystems identified in the basin (EACJP, 2003) are:

- Mountain ecosystem; it is attributed by relief, topography, soil, land use and water condition. It is located mostly in the upper watershed. The residential pattern in this ecosystem is radial centrifugal and clustered in the water springs.
- Hilly ecosystem; Land use varies in this ecosystem, mainly forest managed by State Own Company (Perhutani). The harvesting system used is clear cutting in which remains bushes after harvesting. Seedling system used by this company is agroforestry in which people living near the forest can utilize forest land for agriculture in the seedling stage. Most of the agriculture plant

is cassava, which absorbs many minerals in the soil stimulated by many cassava industries in along the Pekacangan, Sapi and Tajum rivers.

- Terrain ecosystem; this ecosystem is spread from the middle of the watershed to the downstream. The pattern of the river is meandering in which in the certain stage change into braided pattern attributed by the replacement of some water flows in the river from side to side. The surface and ground water in the ecosystem is always available in a year. The main problem is water pollution from many sources: households, industries, and agriculture. Moreover, the intrusion in the downstream also becomes a problem. The estuary area is prone for flooding.

4.7 Environmental Management Problems

Indonesia suffered the economic, political, and environmental shock in 1997-98 remaining relatively larger than other countries in East Asia. The reform aspirations reach into every sector and every corner of the country including natural resources. Resources-rich provinces wants to control over resource based revenues, and local population wants to access the natural resources as denied before. Indonesia will still remain the natural resource-dependent over the next decade, and decentralization in the natural resources sectors, a major item in the reform agenda, creates both risks and opportunities (World Bank, 2001).

There was an engagement from World Bank in the environmental management in Indonesia after 1998. The World Bank plays some roles in the environmental management:

- A set of environmental and natural resource policy and management conditions has been attached to the structural adjustment operations of the World Bank and Letters of Intent of the IMF
- There was a dialogue between the World Bank and experts from Indonesia in developing policy
- The World Bank has prepared the third environmental sector review

Watershed as one of the resources also faces problems. In Serayu watershed, besides actual problems on the environment, the management problems on environment are also identified. In general, the management problems are related to the data and information, planning, human resources, institution and regulations. The problems occurred in the Serayu watershed can be depicted below.

Planning process

In general, the problems identified in the planning aspects are: (1) sectoral planning, which is not fully integrated causing the lack of data and information needed for integration of the plan; (2) lack of capability of the institution in management; (3) lack of the system of coordination, integration and synchronization; (4) top down planning, which is ignoring public participation.

Implementation

In implementing the plan, some problems are occurred, for example: (1) the limitation of the executive authority only in administration, personal, knowledge and technical skills; (2) conflict of interest from many institutions in the watershed and the unimplemented plan; (3) lack of coordination, integration and synchronization of projects in the watershed; (4) lack of participation from the public.

Institutional

The institutional problems in the watershed can be identified as: (1) the incomplete regulations managing the resources in the watershed; (2) lack of the law enforcement on environmental issues; (3) there is no specific institution obliging in uniting, coordinating and integrating all sectors in the watershed yet.

4.8 Environmental Problems

After implementing decentralization concept in which local government has more authority, some problems related to environmental issue occurred, for example: (1) the natural resources is not equally distributed in each administrative area implicating on the disparity among regions and strong emphasis on economic achievement of each local government by exploiting nature rather than conserve it; (2) the different perspective on the development unit where the development unit of environment is ecosystem, in contrary the development unit of autonomy is administrative; (3) the indicators of development performance is mainly focus on economic (income).

Spatial Problems

There are two spatial problems identified in the watershed:

1. Overlapping and unfit use of many land uses. Not all of the land allocation on some purposes is implemented. For example, the river banks along the Serayu River that should be used for flood area are used for residential areas. Some residential areas also occur in the natural conservation area and water catchment area in the upper watershed.
2. The spatial institutionalization, which is not focus on the goals in planning, implementation, monitoring and evaluation due to the fast development in the Serarayu watershed. In addition, the traditional mining areas ignoring the "best practice mining" jeopardize the environmental condition.

4.9 General Strategy

SWOT Analysis

To analyze the potencies and problems in the watershed, SWOT analysis has also been conducted by EACJP in 2003. This analysis consists of internal (Strength and Weakness) and external factor (Opportunity and Threat). The result of SWOT analysis conducted by EACJP (2003) can be described in the **Table 4.6.** and **Table 4.7.**

Table 4.6 Internal Factors of Serayu Watershed Management

Internal Factors	
Strength	**Weakness**
Biophysics component Most of the lands are in good quality and has relatively high productivity	Biophysics component There are also some unproductive areas and disaster prone areas The environment degradation happened in the upper such as deforestation and erosion, while pollution and flooding occurred in the downstream area
Socio economic component The high population with high motivation to improve economic and social condition	Socio economic component In average, the quality of residents are still low, particularly in education and economy (poverty) The environmental concern is still low, as a result of poverty and the pressure on land
Spatial Planning All of the area has already had spatial planning in each administrative area	Spatial Planning The scale of existing spatial planning is very difficult to be implemented as a tool in environmental management The law enforcement on the encroachment of spatial planning
Institutional Most of administrative area has institution addressing environmental issues There is a strong motivation to address the environmental problems	Institutional The institutional setting on environment is still weak The budget on environment is still low The quality of human resources and infrastructure is still low There is no integrated mechanism in dealing with environmental problems The low level of coordination

Source: EACJP (2003)

Table 4.7External Factors of Serayu Watershed Management

External Factors	
Opportunity	**Threat**
Biophysics component The utilization of natural resources to improve people's wealthy The application of technologies to optimize the natural resources utilization	Biophysics component The high pressure of people on natural resources particularly agricultural area The climate change The increasing of industrialization that is not environmentally friendly.
Socio economic component The market demand on natural resources product including agriculture and tourism The job opportunities and good environment for investment in other area as a result of the improvement of national and global economic condition.	Socio economic component The population growth, particularly in productive age is imbalance with the increase of job opportunities The very high demand of market on natural resources product The changing culture of the people to be more commercially and economicly in looking at resources
Spatial Planning The relation between provincial spatial planning and the area has endorsed some area in the watershed (the Dieng area) to be a priority area. The integration of Spatial Planning in each administrative area in watershed perspective	Spatial Planning The intervention of residential, industrial, and mining area into the conservation area
Institutional The law related to environmental management claims the serious handling with a strong institution and adequate budget. The opportunity to have cooperation with central and provincial government and other parties The improvement of capability of human resources and related institutions	Institutional The weakness of environmental institution in provincial and central level The assumption that the environmental problems including institutions as obstacle of development.

Source: EACJP (2003)

Vision, Missions and Goals of Serayu Watershed Management Plan

It is important to define a clear vision of a plan to give a general guidance in developing frameworks, strategies, programs, and projects of the plan towards this vision. The vision developed in Serayu watershed management plan is "*achieving the integrated management focusing on maintaining the resource stability and sustainability, reducing environment degradation, be able to increase public wealthy, based on participation and partnership*" (EACJP, 2003).

The missions of Serayu watershed management plan are (EACJP, 2003): (1) Achieving integrated watershed management by developing integrated institution,

planning and coordination supported by capable human resources; (2) Promoting development programs, which are able to ensure stability and sustainability of resources and reduce environmental degradation; (3) Improving wealthy without relying only on natural resources and creating job opportunities to reduce poverty; and (4) Empowering and giving as much as possible room for public participation for all stakeholders, including society, private, and institutions in watershed management.

The missions defined above can be elaborated into several goals guiding the programs and projects in more practical way to achieve the good condition of the watershed. The goals defined in the master plan are (ECJP, 2003):

1. Establishment of integrated watershed planning system involving many sectors, agencies, and inter region.
2. Good and continuous coordination system in dealing with environmental problems particularly in watershed context
3. Human resource capability in dealing with environmental problems indicated by level of education, skill, and professionalism in handling environmental problems
4. Strengthening environmental institution position in each administrative area mainly based on the reliable planning and coordination system
5. Increasing the budget proportion on environment
6. Establishment of firm and continuous partnership vertically and horizontally
7. Provided development programs in environment and other programs related to environment
8. Minimum environmental problems intensity, such as forest degradation, erosion, landslide, pollution, flood, etc.
9. Providing operational guidance in dealing with environmental issues
10. Providing directions of steps to be taken in improving public wealthy
11. Providing alternative steps in minimizing society's reliability on land, providing job opportunities, and extending job opportunities to alleviate poverty.
12. Achievement of as much as possible room for participation and partnership of all stakeholders.

4.10 Concluding Remarks

This chapter mainly discusses the case study's characteristics to get more insight of the case study. The history of water management in Indonesia is also described. It begins with what is called "development decades" in 60s - 80s characterized by the important role of local leaders and religious institutions in irrigation management. The main focuses of water management of this period are irrigation, river improvement, urban drainage, agriculture, housing and settlement, water quality, management of rivers, flood control, and drought prevention. The watershed management was also introduced in this period. The second epoch is the system management in 80s - 90s focusing on the changing view from development to water system. The last period is the reform period characterized by the important

role of multinational agencies in water sector in assisting the institutional design and policy.

The Serayu watershed is described based on the data availability related to the research. The Serayu watershed encompasses 5 administrative regions: Wonosobo, Banjarnegara, Purbalingga, Banyumas, and Cilacap. The annual rainfall rate varies from 1,821 mm/year in Klampok (Purbalingga) up to 4,477 mm/year in Pringombo (Wonosobo). The climate is mostly included in B and C category of Oldeman classification, which has wet months in a year from 5 – 9 months. In general the quantity of water is enough for the watershed need indicated by the humidity index between 50-500%. But, the quality of water is still below the standard of quality indicating the pollution on water. It is caused by the organic matter from traditional market and households along the river, industrial disposal, agricultural waste, and erosion.

Serayu watershed consists of several type of soil: alluvial, regosol, litosol, andosol, latosol, grumusol, and podzolik. Each of this type of soil has specific characteristics related to best land use. For example, the alluvial is mostly appropriate for paddy field. There are some tributaries in the watershed, Begaluh, Tulis, Merawu, Klawing, Banjaran, Sapi and Tajum. Land use varies in the watershed and dominated by the dry land area. The biophysics problem is identified as air and climate problem, and water resource problem. This research will focus mainly on water resource problem.

The socio economic problem in Serayu watershed is indicated by the low education level and high poverty level. The education level is around 90% in low level, while the poverty level is around 40 %. Other problems indicated are population growth, land pressure, unemployment, and low participation of citizens in decision making.

In general, after crisis of economic, political and environment in 97/98, Indonesia remains larger impact than other East Asian countries. The decentralization, the major agenda or reformation, creates both risks and opportunities related to natural resource management. Indonesia will still remain the natural resource-dependent in the next decade, thus the wisdom in utilizing natural resources based on sustainability concept is a must. Some basics problem related to management of the watershed is identified in three levels: planning process, implementation and institutional. The lack of integration among policies and local governments and weak of participation of citizens in the decision making are the main problem highlighted.

The general strategy in dealing with occurred problems is developed by the SWOT analysis. This general strategy is depicted in vision, mission and goals. The vision of Serayu watershed is "*achieving the integrated management focusing on maintaining the resource stability and sustainability, reducing environment degradation, be able to increase public wealthy, based on participation and partnership*" (EACJP, 2003).

Chapter 5 The Assessment of Sustainability in Serayu Watershed

This chapter elaborates the application of sustainability assessment developed in chapter 3 through criteria and indicators of sustainable watershed management, in Serayu watershed based on the strategies developed and policies made related to water issue. The environmental, social, economic and institutional aspects of sustainability are described. The strategies developed by each aspect are also drawn to give more understanding of the context.

5.1 General Strategy

The general strategy in Serayu watershed management is developed based on the condition, facts, problems and data that are available to achieve sustainable water resource management. This general strategy will be used as a reference for the regulations and policies below it, for example local regulations. The general strategy includes vision, missions, and goals as described in the Chapter 4.

From the vision made, it is clearly stated that the utilization of resources should guarantee the stability and sustainability without harming the environment. The use of resources is aimed at the improvement of wealthy of the people, which is based on participation and partnership. The IWRM concept as promoted in WSSD (2002) in Johannesburg as a key in achieving sustainable water management is adopted in this vision. The plan of Serayu watershed management has tried to define the vision in line with the sustainability concept that try to accommodate the environmental, social, economic and institutional dimensions. To achieve the vision, some missions have also been developed.

The missions of the plan seems to be ideal because it uses the integrated watershed management supported by the capable human resources aiming at the balance between economic (improving wealthy by creating job opportunities and alleviating poverty), social (public participation), environment (sustainability of resources and reducing environment degradation), and institutional (public, private, institutions involvement).

From the goals described in the previous chapter, it seems to be very general goals that still give unclear targets. For example, all of the goals do not explain the range of time to achieve. Those goals don't present the measurement unit either, which can be interpreted differently, thus it can be fuzzy and complex. Local government which will implement the programs and projects referring to these targets can interpret differently. In contrary, one of the prerequisites of sustainability concept applied in the plan is the clear of goals.

5.2 Assessment on Environmental Aspect

Indicators Tested

There are several indicators in environmental aspect used in the assessment of sustainability in Serayu watershed: the budget allocation on environment, percentage of agricultural and forest area, and the quality and quantity of water.

Budget Allocation on Environment

The analysis conducted by the World Bank in 2001 in public expenditure on environment in Indonesia found that in the period of fiscal year 94/95 – 98 /99 the public expenditure on environment activities is extremely low. In fiscal year 94/95 the public expenditure on environmental activities is only about a third. In fiscal year 97/98 – 98/99, the environmental expenditure fell from 0.9 to 0.5 percent and from 0.04 to 0.02 of total GDP.

In regional level, the environmental expenditure suffered deep cuts since the crisis and the allocation of the total national environmental budget is more in central activities (World Bank, 2001). In the decentralization era, it promotes the relatively higher portion of expenditure in the local and regional level than in central level. Improving the local environmental management seems to be impossible without provision of human resources and financial supports. The increase of budget portion for environmental activities is an indication of sustainability concept to be applied in an area.

In the fiscal year of 1999/2000 the average budget allocation in each regency in the Serayu watershed is higher than in national level. It varies from 6.65% in Cilacap regency to 12.78% in Wonosobo regency. In fiscal year 2000 there are several changes in the allocation. Cilacap, Purbalingga, and Wonosobo reduced their budget on environment. In contrary, even not high, Banyumas and Banjarnegara regency have increased their budget allocation on environment. The budget allocation on environment can be seen in the **Table 5.1.** and **Figure 5.1.**

Table 5.1 Budget Allocation on Environment in Serayu Watershed (in thousands Rp)

Budget Allocation		Regency				
		Cilacap	Banyumas	Purbalingga	Banjarnegara	Wonosobo
Environment	1999/2000	3,372,591	3,217,948	1,523,177	1,786,677	2,437,462
		6.65	10.70	8.15	9.61	12.78
	2000	1,417,965	3,284,339	787,146	2,001,909	1,713,886
		3.35	11.50	4.84	12.37	11.45
Non Environment	1999/2000	47,370,779	26,852,517	17,163,519	16,796,097	16,634,064
		93.35	89.30	91.85	90.39	87.22
	2000	40,896,290	25,276,780	15,477,953	14,184,578	13,251,227
		96.65	88.50	95.16	87.63	88.55
Total	1999/2000	50,743,370	30,070,465	18,686,696	18,582,774	19,071,526
	2000	42,314,255	28,561,119	16,265,099	16,186,487	14,965,113

Source: EACJP (2003)

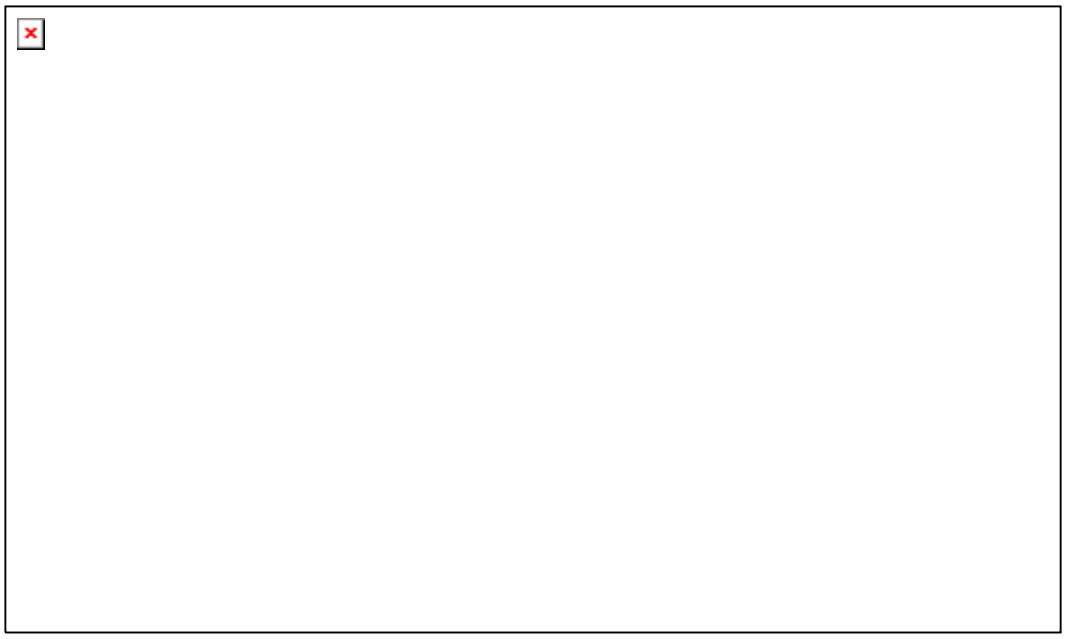

Figure 5.1 Budget Allocation on Environment in Serayu Watershed
Source: Modified from EACJP (2003)

Agriculture and permanent crop land area and forest area

The sustainable agricultural land can guarantee the food production and improve its function in land resources. In addition, CSD (2001) describe that agricultural area can support the socio-economic development and maintenance of rural lifestyle. The sustainable practiced in a sustainable manner can contribute to the conservation of rural area and other related resources, such as soil, mineral, water, plant and animal communities. In Serayu watershed, where the percentage of agricultural area is 49% (19% paddy field and 30 % dry land) can be a high potent in guaranteeing the food security in the watershed. The proportion of land use in Serayu watershed can be seen in the **Figure 5.2**.

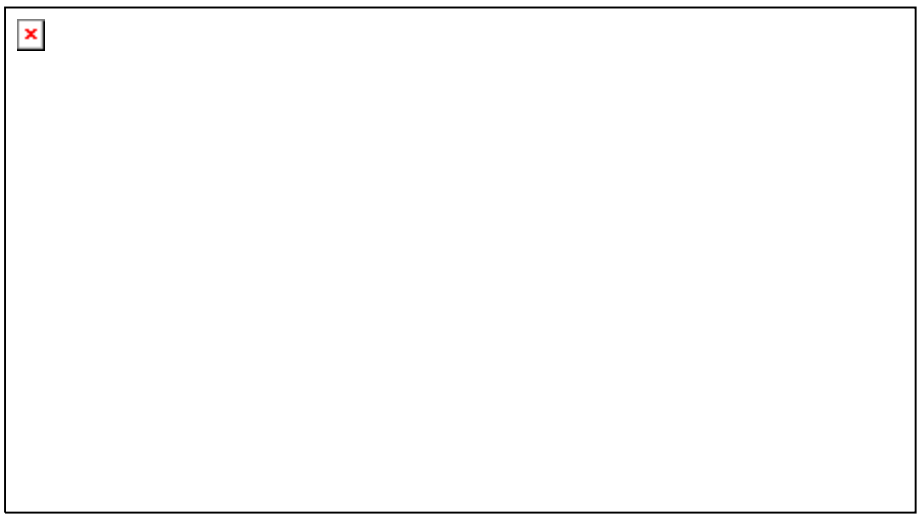

Figure 5.2 Percentage of Land Use in Serayu watershed
Source: modified from EACJP (2003)

The percentage of forest area in a catchment area can determine the hydrological function of a catchment. Forest can be a stream regulator, which retains water in the rainy season and releases it in the dry season. Some researches in forest hydrology show that the reducing of forest area in a catchment can influence the hydrological characteristics of the catchment (Asdak, 2002). In general, the increasing of peak flow is caused by the reducing capacity of transpiration (evaporation from vegetation) that causes the increasing of run off and ground water flow. The research result about the relationship between forest and hydrology can also be seen in the **Figure 5.3.**

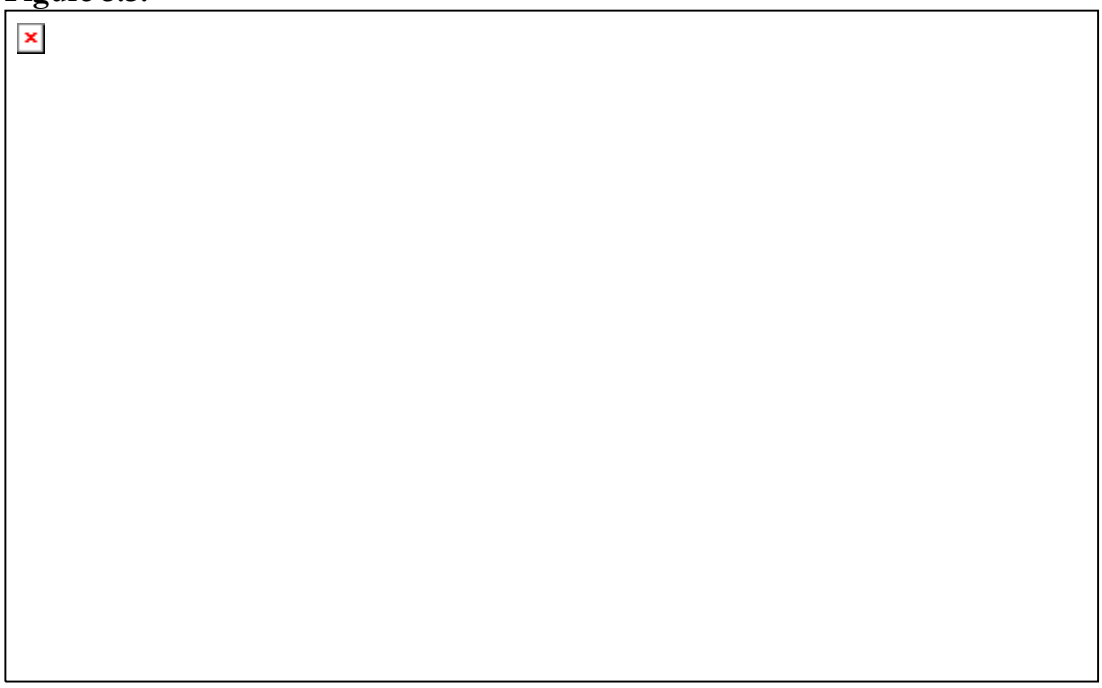

Figure 5.3 Response of stream flow peak discharge to percent of a basin in open land or young forest.
Source: Ice, Kolka and Gilmore (2005)

The research conducted by Verry (2004) cited by Ice et al (2005) noticed that the peak discharge is influenced by the percentage of the open or young forest in the basin/watershed. The more open and young forest in the basin, the higher peak flow will happen. It is because of the function of the forest as a "sponge" which retains and restores water when raining and releases it when not raining. The minimal percentage of forest area in a basin is determined to be 30% based on Indonesian Forestry Law No. 41/1999. This minimal percentage is assumed to be an ideal forest that can give optimal hydrological function in a basin. In Serayu watershed which only has 19% forest area can be concluded that the forest function in the entire basin is not as ideal as should be. The hydrological function of the forest is not optimal, thus the sustainability of water resources is not fulfilled from this point of view.

Fresh water quality and quantity

As a resource, water can only be used in a certain quality by humans for different purposes, such as drinking water, agriculture, industry, recreation, fisheries,

hydropower, and so forth. The quality requirements of each purpose are also different. But, the better quality of water can be used for more uses rather than the bad quality of water. Thus, the monitoring of water quality is needed to ensure the quality of water available for many purposes. To measure the quality of water, some criteria such as physical, chemical, and biological are used. The indicators used in this research for water qualities are based on the data availability in the master plan and other related resources.

The physical indicator used in this research is Total Suspended Sediment (TSS). This indicator is related to turbidity of water caused by soil erosion in the upper. The high sediment in the water can obstruct sunlight get into the water body that can impede photosynthesis process for water vegetation. The sun impediment can also threat the aquatic fauna due to the low temperature of water and the minimal food. The standard of TSS for good quality of water is 50 ppm. The TSS level in the Serayu watershed can be seen in the **Figure 5.4**.

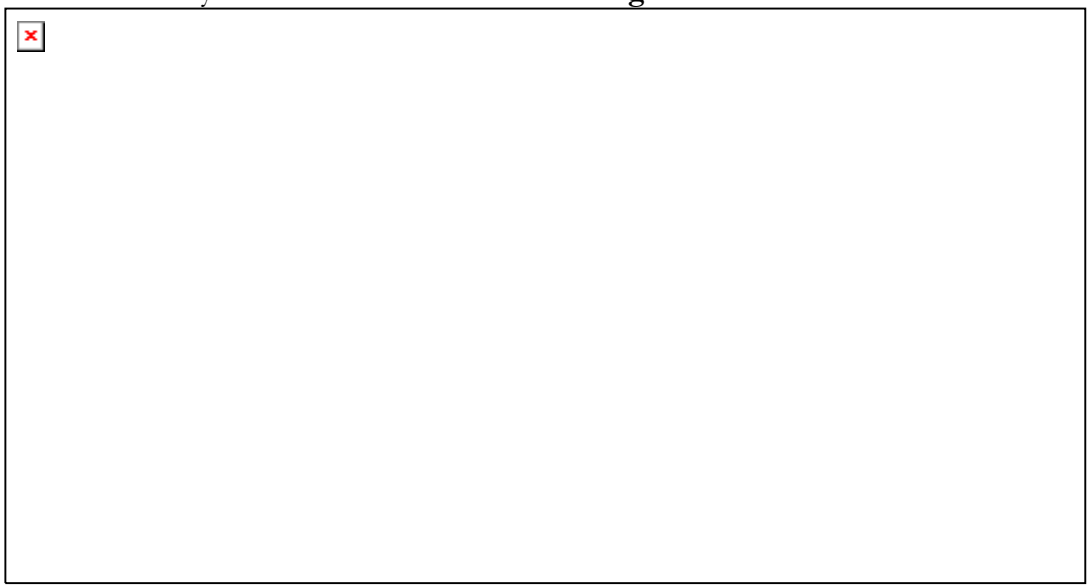

Figure 5.4 The TSS level in dry and rainy season in Serayu watershed
Source: adopted from EACJP (2003)

From figure above, it can be seen that the TSS level is much lower in the dry season than in the rainy season. In dry season, the TSS level in all point samples is below the standard that is good condition. Nevertheless, in the rainy season, most of the point sample indicates the very high TSS level. This condition indicates the high soil erosion in the upper in the rainy season.

The biological indicator used in this research to assess the quality of water is Biological Oxygen Demand (BOD), which shows the oxygen index needed by biodegradable pollutant in a aquatic system during the anaerobic decomposition process. In other word, BOD can be the indicator in assessing the pollutant level in the aquatic system. The higher the BOD, the lower oxygen freely in the water, the higher the pollution happens. The standard of BOD in this research is 2-3 ppm. The BOD level in the Serayu watershed can be seen in the **Figure 5.5.**

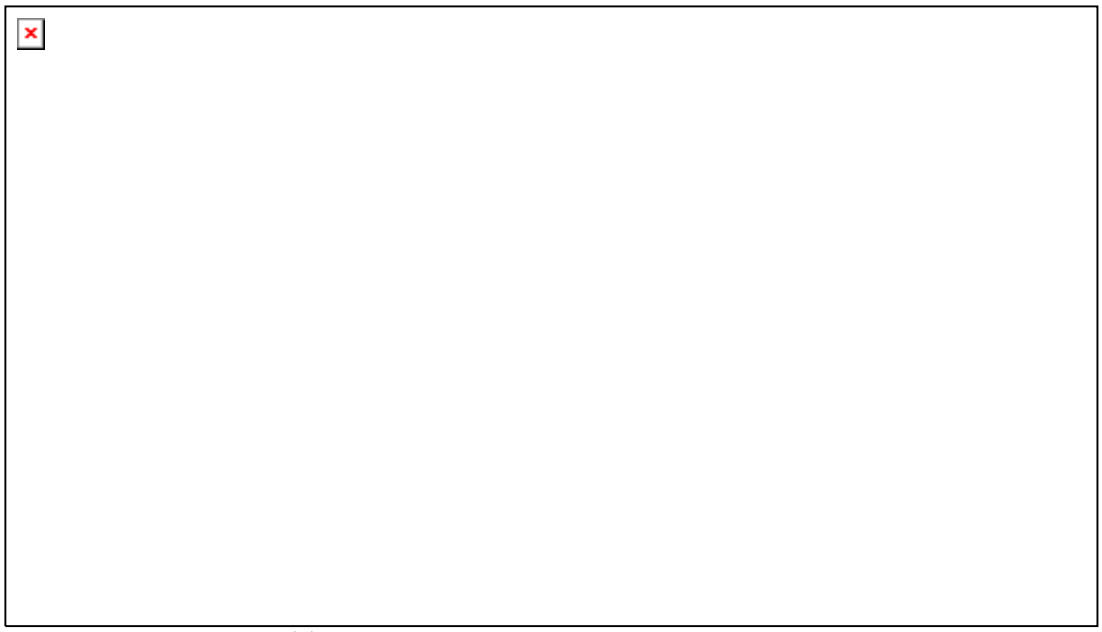

Figure 5.5 The BOD level in dry season in Serayu watershed
Source: adopted from EACJP (2003)

From **Figure** above, it can be seen that most of the point samples suffer the high BOD level indicating the high pollution on water. The BOD level varies from 1.7 ppm in Serayu Hulu, Serayu Tengah, and Tajum to 33.5 ppm in Pekacangan sub watershed.

Like BOD, Chemical Oxygen Demand (COD) also shows the independent oxygen in the water that can be used for the aquatic ecosystem. The higher the COD level, the lower independent oxygen available in the water, indicates the high pollution occur in the water system. The standard used for COD in this research is 10 - 25 ppm. the COD level in the Serayu watershed can be seen in the **Figure 5.6.**

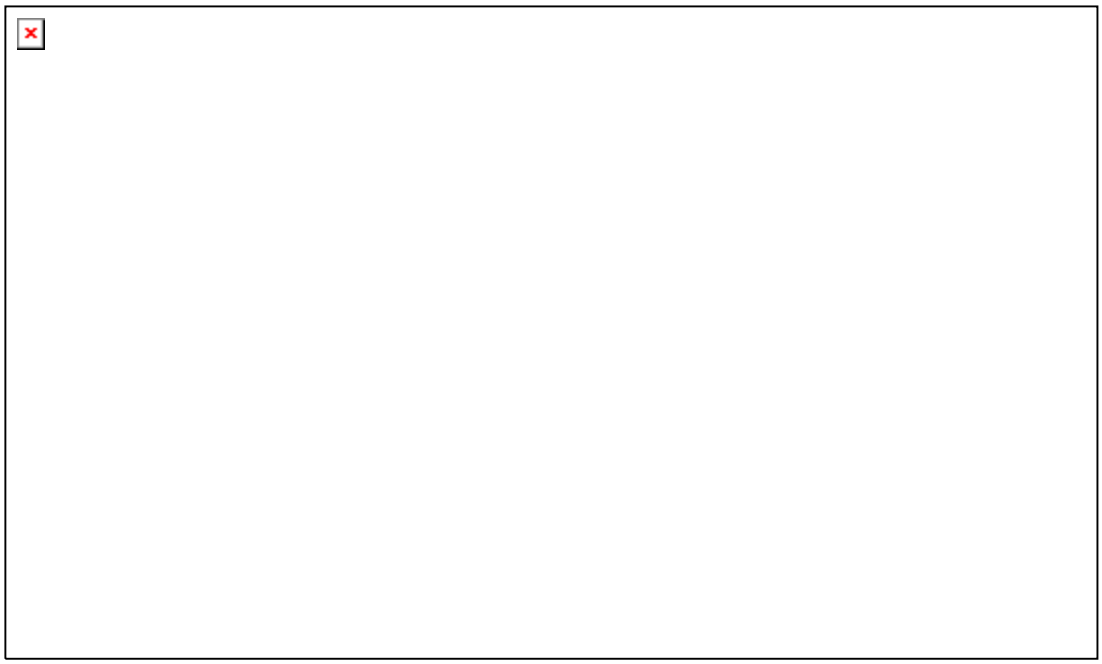

Figure 5.6 The COD level in dry season in Serayu watershed
Source: adopted from EACJP (2003)

In general, it can be concluded that the water quality indicator is still in low level meaning that the quality of water in the Serayu watershed needs improvement. The high TSS level has a strong indication of high land erosion in the upper. Therefore, the soil conservation techniques need to be improved and introduced to the people in practicing the agricultural area. BOD and COD indicate the high pollution in the Serayu watershed. From this point of view, the sustainability of water is not fulfilled yet. Some improvements on water quality need to be developed.

Water is not only seen from its quality, but also quantity showing the availability of water for humans and living things. In watershed system, the water input is mainly from rainfall. The watershed will process the water input from rainfall in some ways such as evapotranspiration, infiltration, run off, and to be released as water discharge. The water balance model using Thornwaite-Matter is used in predicting the water availability in the Serayu watershed indicated in Surplus Water and Humidity Index. The result of the model applied in Serayu watershed can be depicted in **Figure 5.7.** and **Figure 5.8.**

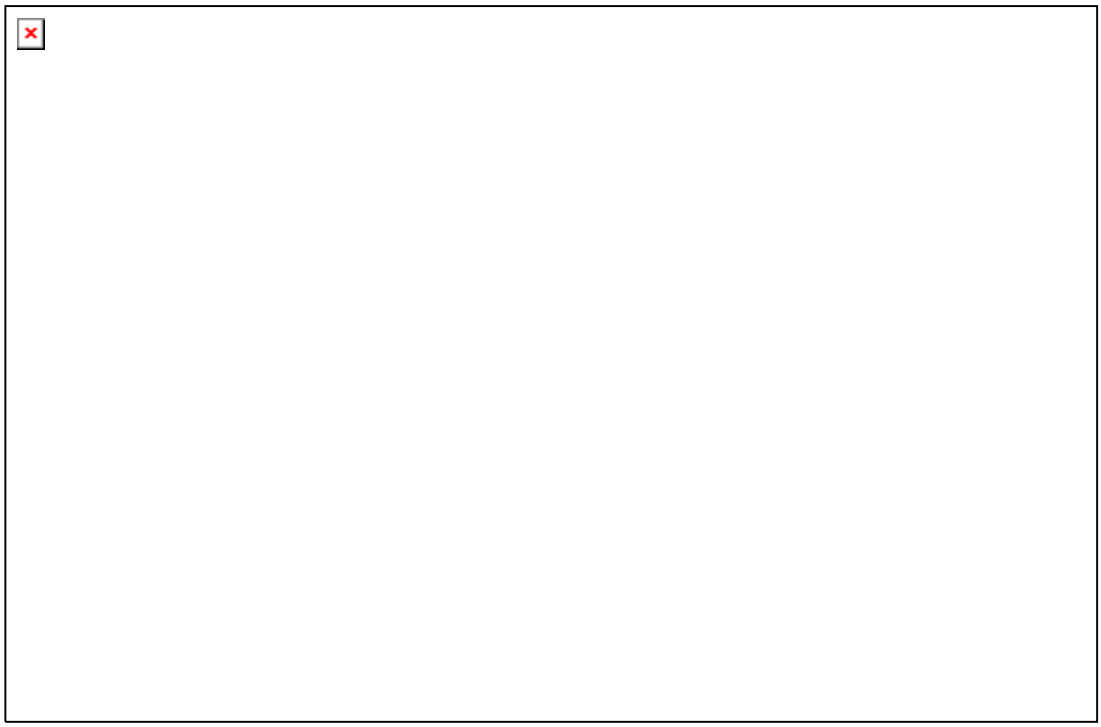

Figure 5.7 The Water Surplus in Serayu Watershed
Source: adopted from EACJP (2003)

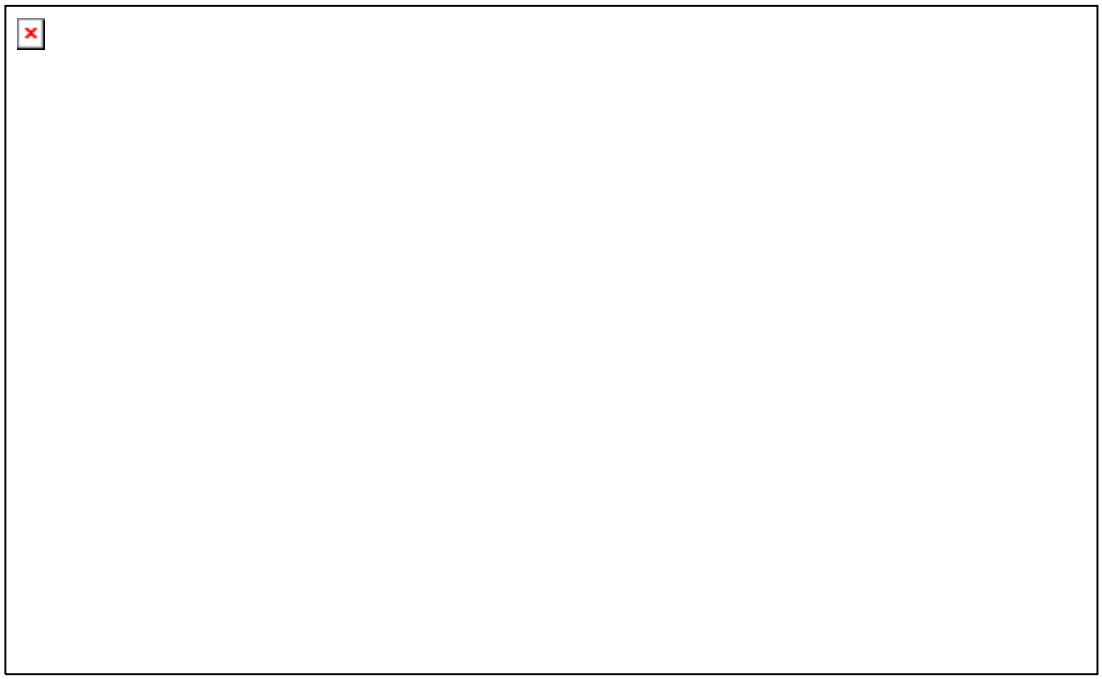

Figure 5.8 The Humidity Index in Serayu Watershed
Source: adopted from EACJP (2003)

The humidity index also shows the water availability in an area. There are three level of humidity index: low (0 -10) showing that water is enough for the area, medium (10 – 20) showing that water is more than enough for an area, and high

(>20) depicting the abundant water for the area. From **Figure 5.8** above, it can be seen that all of the point samples have the humidity index more than 20, which means that water is abundant in the Serayu watershed. But, this indicator needs to be complemented by the water availability in a year that can be approached by the average rainfall in a year. The rainfall rate in Serayu watershed can be depicted in **Figure 5.9.** The lowest rainfall rate is in June – September while the highest is in November – January.

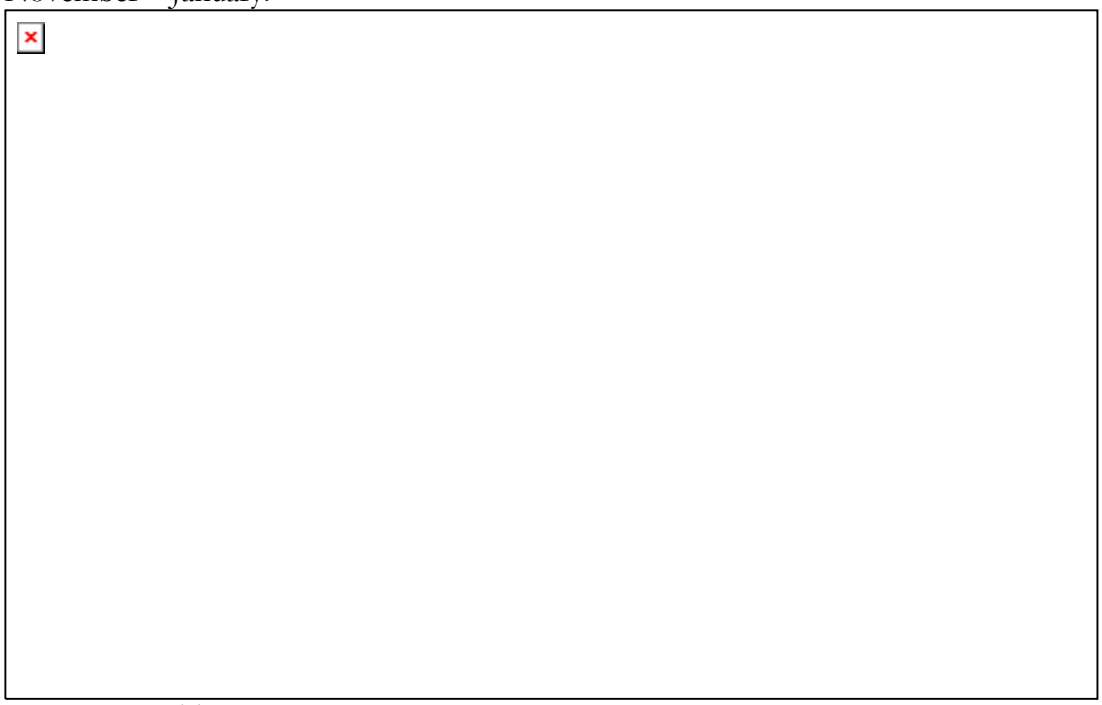

Figure 5.9 The Rainfall rate in the Serayu Watershed in a year in some stations
Source: modified from EACJP (2003)

Strategies Dealing with Environment Problems

The general strategy in dealing with environmental issues in the watershed adopts the Agenda 21 principles by dividing area into ecosystem units. Environment has many functions on humans, such as: providing resources for living, place for living and development, place for waste and development results. and as a part of ecological system.

The general strategy in Central Java province in dealing with environmental issues are: (1) focus on the renewable resources; (2) minimizing the use of the natural resources; (3) rehabilitation on the environment degradation; (4) spatial planning; (5) weighting the scarcity value for scarce resources; (6) maintaining the natural resources capability in achieving the sustainable development; (7) promoting the sustainable development implementation; (8) boosting the decentralization based on the public owhnership, participation, democracy, role of public, and check and balance; (9) applying the sustainable development in all sectors by emphasizing on the sustainable management, economic, ecology and technology; (10) balancing the development programs based on the synchronization on local spatial planning and integrated environmental planning.

In the Serayu watershed plan, there are also some strategies focusing on forest, soil, and water conservation, which are related to environment. First, the development of forest functions through agroforestry to improve both economic and environment. Agroforestry as one system in land use is now widely accepted due to its benefit to socio economic and environment, and also one way to empower farmers to conserve resources in rural area. Second, strategy on reforestation and rehabilitation on forest through an appropriate approach is necessary to be done. Third, landslide control in forest area through vegetative and technical approaches, such as: avoiding unplanned cutting in the forest, planting forest trees with intensive and deep root

The strategies developed by the province have fully adopted the sustainability concept indicated by the focus on utilizing the renewable resources, minimizing using resources, and rehabilitating the degraded environment. These strategies give more attention to the environment emphasizing on the present and future generations. Some other strategies also indicate the sustainability concept applied in the watershed. In the master plan, the focus of the environment strategy is on agroforestry, rehabilitation and reforestation, and landslide control included in the forest, soil, and water conservation strategy.

5.3 Assessment on Social Aspect

Indicators Tested

In social aspect, there are several indicators used in the assessment: *poverty, education,* and *population growth*. The poverty level in Serayu watershed is very high. Almost half of the residents is still below poverty line with the highest poverty rate is in Karangreja sub district, Pubalingga (63.42%) and the lowest poverty rate is in Watumalang, Wonosobo (10.89%). CSD (2001) states that poor people may feel powerless and isolated, pervasive and systematic problems related to insecure livelihoods, malnutrition and poor health, illiteracy, civil insecurity and corruption. The concentration of the poor in the marginal land in the rural area can cause the resource over exploitation and land degradation.

Hirji and Ibrekk (2001) argue that there are sixth dimensions of poverty need to be address regarding the close links between environment and water resources interventions. First, sustainable growth requires not only on developing the natural capital (water resources) for human development and welfare, but also protects the essential function of water for human health and natural capital from irreversible damage. Second, equity requires equitable laws that will ensure the property rights by restricting access to and control over natural resources properly. Providing good equitable use rights of water, fisheries and logging will provide the desirable incentives and means for managing natural resources in sustainable manner. Third, the improvement of humans' health by diminishing their exposure to waterborne and vector-borne diseases and to toxic substances by increasing access to clean water and adequate sanitation is necessary to be done.

Forth, natural resources remains the most essential safety net available for the poor in rural households although it seems reducing dependence on natural resources may be a more effective way of poverty. Ensuring poor people in rural area to access water, land, forests and biodiversity is the wise way to achieve sustainability.

Fifth, the poor people, particularly in rural area are commonly vulnerable to both natural disasters and changes on environmental conditions. This vulnerability can be reduced by getting information from governments, private sector and poor communities and by promoting adaptive strategy. Sixth, the participation of all stakeholders in decision making, equipping people with the ability to monitor and influence public resource allocations, creating user organizations, transferring operation and maintenance responsibility to the users, and so forth should support the empowerment of people to manage their own environment and water resources. The education, then, is also an important indicator.

In education indicator, it is assumed that the higher the education level, the better knowledge people have so that the environmental concern is also getting better. In the Serayu watershed it is proved that in some areas where dominated by low education people, the environmental condition is degraded more intensively than area where dominated by higher education. The education level in Serayu watershed in general is still low. In average, 90.69% of the total residents only have basic education. The highest proportion of basic education is in Pagaten sub district, Banjarnegara (98.13%) and the lowest proportion is in Purwokerto Utara sub district, Purwokerto (59.73%).

Based on this condition, it can be concluded that the low education level in the Serayu watershed contributes on the environmental degradation and obstruct the sustainability concept to be applied in the watershed. Education can improve people in meeting their basic needs, capacity building, access to information, and strengthening science (CSD, 2001). Moreover, education can be a tool in changing consumption and production patterns to more a sustainable path. The higher education can make people more optimize in playing their role as human beings and societies to achieve ethical awareness, values, attitudes, skills and behavior in line with the goal of building more sustainable society. In contrary, the low education has multiplier effect on worsening the poverty problem, participation process in decision making, and environmental concern.

The last indicator to be tested in social aspect in this research is population growth. The population growth in the Serayu watershed in 1999-2000 is 0.97% which is relatively very low. CSD (2001) points out that the more stable of fertility can have a considerable positive impact on quality of life. But, the rapid urbanization growth and migration can stimulate to unsustainable living conditions and increased pressure on environment, particularly in ecologically-sensitive area. From this indicator point of view, the sustainability of watershed is contributed by this low population growth.

Strategies in Dealing with Social Aspect (Participation)

The strategies in dealing with social aspect are not specifically defined in the master plan. Some strategies have a strong relationship with economic aspect, particularly in dealing with poverty and education issues. But, there are several strategies in the master plan that can be identified as social strategies:

- The requirement of a successful watershed management is participation. Thus, the all decision making level including planning, implementation and evaluation must give room for participation for all stakeholders.

- Building partnership in optimizing utilization of natural resources, particularly water. The partnership can be with public and private or foreigner.
- Establishing an appropriate partnership model

The strategies developed above indicate that not the entire sustainability concept to be applied in the master plan from social point of view. For example, there is no specific strategy in dealing with education problem, which is very low in average. One of the prerequisites of the participation as become the first strategy in this master plan is education. The higher the education, the better the participation would be. But, the social sustainability as elaborated in chapter 2 is strongly recommended to be improved in the master plan that is improving the social network through partnership. This is a good point in building institutional capital, one path to achieve social sustainability.

5.4 Assessment on Economic Aspect

Indicators Tested

The sustainability assessment on economic aspect uses several indicators to be tested. The most widely used is GDP per capita. In this research, the economic structure and economic growth also will be used to give a better understanding of the case study. The economic structure will describe the sectors contributing to local income. It is closely related to the economic potency and steps to be taken to improve economic condition. The economic growth also indicates the improvement of the economy as one of the sustainability dimensions. The economic structure of the Serayu watershed can be described in **Table 5.2.**

Table 5.2 Economic Structure of Each Regency in Serayu Watershed

No	Regency	Agriculture	Industry	Service	Total	% of GDP on watershed	% agriculture	% Industry	% Service	Dominant
1	Wonosobo	783,388	15,420	648,528	1,447,337	16.59	8.98	0.18	7.43	Agriculture
2	Banjarnegara	1,046,622	365,053	976,647	2,388,322	27.38	12.00	4.18	11.19	Agriculture
3	Purbalingga	686,228	206,514	888,557	1,781,297	20.42	7.87	2.37	10.19	Service
4	Banyumas	931,267	697,213	1,478,619	3,107,100	35.62	10.67	7.99	16.95	Service
Total		3.447.505	1,284,201	3,992,351	8,724,058	100,00	39.52	14.72	45.76	

Source: WMTC a (2004)

From **Table 5.2.** above, it shows that the trend of GDP in the upper is more influenced by agricultural sector, while in the downstream the service sector is more dominant. The impact on watershed management from those sectors is different. In the upper where the agricultural sector is more dominant, the erosion and sedimentation commonly happen. While, in the downstream where residential area, industry, and other infrastructure have been built tends to have high water flow due to the low capacity of infiltration.

Table 5.3 The GDP per capita of Serayu Watershed in 2002

No.	Regency and City	GDP in 2002 (million Rp)	Total Population	Average annual income (Rp)	National average annual income (Rp)
1	Wonosobo	1,687,100.38	750,939	2,246,654.36	7.262.048
2	Purbalingga	1,904,743.38	795,874	2,393,272.53	7.262.048
3	Banjarnegara	2,608,863.42	848,317	3,075,340.26	7.262.048
4	Banyumas	3,312,730.46	1,472,122	2,250,309.73	7.262.048
Total		9.513.437.64	3,867,252	2,491,394.22	7,262,048

Source: WMTC a (2004)

The average annual income of Serayu watershed is much lower than national average. From the economic parameter, the Serayu watershed is in bad condition. Banyumas regency even though has relatively high GDP; it is still in lower level than national GDP due to the high population in Banyumas regency. To increase the income, the improvement on economic growth is needed. Economic growth can be stimulated by the increasing of investment, technology and skills of human resources.

The study of the relationship between investment and economic growth has been conducted by Harod in 1939 and Domar in 1946 (WMTC, 2004). It found that the poor people as a result of lack of capital in an area can be improved by capital injection from outer area. This theory is based on the previous theory about poverty stated that the low economic growth is caused by the low productivity of the people (Nurse, 1935) in WMTC (2004). The low productivity of the people influence the low average income, then the saving is also low. The low of saving will cause the low of investment, and then will cause the low of economic growth. Therefore, the investment injection from outer area is an effective way to reduce the investment gap that in turn can stimulate economic growth. But, due to the lack of capital and skills of the government, the investment should come from private. Hence, the government can only facilitate the good environment for investment in the area.

The investment on the Serayu watershed can be injected not only on agricultural sector (on farm) but also on the industries. For example, the investment on wood industry will stimulate the farmers to enhance the wood production on their farm, thus will increase their income.

The economic growth in regencies in the Serayu watershed is in average of 3.69%, lower than the national growth 4.8%. The economic growth in downstream triggered by industry and service sector (Banyumas and Purbalingga) is higher than in the upper dominated by agricultural sector (Wonosobo and Banjarnegara). The economic growth in the Serayu watershed can be seen in **Table 5.4.**

Table 5.4 GDP and economic growth in Serayu watershed

No.	Regency	GDP in 2002 (Rp)	GDP in 2001(Rp)	GDP deviation	Growth (%)
1	Wonosobo	538,303.46	527,635.31	10.668.15	2.02
2	Purbalingga	649,626.30	629,866.08	19.760.22	3.14
3	Banjarnegara	865,229.20	852,466.99	12.762.21	1.50
4	Banyumas	1,075,573.98	1,040,236.79	35.337.19	3.40
Rata-rata		782,183.24	762,551.29	19,631.94	2.57

Source: WMTC a (2004)

From some economic indicators above, it can be concluded that Serayu watershed is threatened by relatively high pressure of exploitation in more intensively due to the low of economic performance. Other indicator, such as unemployment rate is not available quantitatively, thus it is not used for the assessment. The contribution of economic aspect in sustainable watershed management is relatively low. Or in other word, the sustainable watershed management should give more attention to economic aspects, so that the watershed can be used not only for present generation but also future generations. The strategy in dealing with this economic problem is described in the following sub chapter.

Strategies in Dealing with Economic Problems

Based on the economic condition above, some strategies are developed. Basically, these strategies refers to the problems occurred in the watershed. These strategies are still general and need to be implemented in more operational projects. These strategies are:

- Partnership based management, which involves public in utilizing economic resources such as dam, forest in the upstream, thus on one hand, people can get economic benefit, and on the other hand, forest can be conserved.
- Providing and extending the job opportunities continuously both in agricultural sector and non agricultural sector to diminish people's pressure on land
- Diversification of agricultural pattern to increase the land productivity
- Improving the education and skill level for society as instruments to be more mobile vertically and horizontally. For example, the education on market knowledge will optimize farmers' income, thus the pressure on land will be reduced.
- Promoting more mobility for the people in the region (basin) particularly the poor.

The strategies developed above indicate the sustainability concept to be applied in the watershed. For example, partnership based management strategy will focus not only on economic aspect which try to use natural resource more optimally, but also focus on forest conservation The partnership based management also indicates the participation aspect which is good for program implementation. The extension of job opportunities not only on farm land but also in secondary and tertiary sector can reduce the reliability on land on one hand, and can improve economic condition on the other hand, which in turn can minimize social problems such as education, poverty, etc. Diversification on agricultural pattern will stimulate farmers to get better knowledge in farming such as productivity knowledge and more market for their products. The education for farmers particularly in market knowledge can improve farmers' entrepreneurship that is hoped to make them better farmers, particularly from economic point of view.

5.5 Assessment on Institutional Aspect

Indicators Tested

National strategy on sustainable development has developed by Indonesian government. It is called The Agenda 21 Indonesia document consisting of unified view and aspiration of ideas which can be integrated into the planning process at every level of Indonesia's development. Thus, government agencies, private sectors and society at large can use this document as a reference for planning and program implementation. There are four main issues elaborated in the document: human services, waste management, land resource management and natural resource management. The management of water resources is included in the land resource management issue. The entire document has been developed and scrutinized by sectoral aspects, government officials, NGO's, academic and others, so that it can be said that the document is a consensus document reflecting many ideas from all stakeholders.

There is also Portfolio of Water Actions (PWA) as a compilation of the statements of actions to be taken voluntarily that are submitted by Indonesian government consisting of who, what, when, where, why, and how specific outcomes defined in WSSD and UN Millennium Development Goals to achieved. There are five themes in this PWA: water and sanitation, water for food and rural development, water pollution prevention and ecosystem conservation, disaster mitigation and risk management, and water resources management and benefit sharing.

Referring to Government Regulation No. 82/2001, the Ministry Coordination of Economic Affair also issued Ministerial Decree No. 15/M-EKON/12.2001 on The Direction of National Water Resources Management Policy. This Decree set a policy direction on water resources conservation: (1) to increase and restore water availability for benefits of present and future generations, (2) to increase and restore water quality to fulfill water demand for present and future generations, and (3) to restore and maintain water resources environment bearing capacity to ensure water availability for fulfilling demands of present and future generations.

From the policies made above, the indicators of sustainability are fulfilled from the institutional point of view. Indonesia has already developed some policies related to sustainable development in general and also sustainable water resources management in particular. Besides, local government has also made some regulations on environment which can be included in the sustainable development policies. In addition, the institutional setting made in Serayu watershed elaborates the effort to achieve the integrated watershed management which gives concern on sustainability. The strategies in dealing with spatial planning are also described to give better understanding on the efforts on sustainable development.

Strategies in Dealing with Institutional Aspect:

Based on the problems occur in Serayu watershed, some strategies in dealing with institutional aspect have also developed. First, improvement of Serayu watershed institutional capability by advancing the human resource capability focusing on: government officers (through training, education, applicable techniques), and communities' leader (through socialization on the importance of

environment). Second, inventing and evaluating the natural resources and environment by developing reliable information system used for planning and implementation of programs. Third, researches related to both spatial planning (in many levels: macro, meso and details) and sectoral are important. Forth, the mitigation system is developed to reduce the risk of natural disaster and to be an early warning system. Fifth, coordination institution needs to be established immediately. Sixth, institutional regulations in every level to implement the higher law or regulations are necessary to be developed.

Institutional Setting to Achieve Effective and Efficient Management

Basically, the mechanism of Serayu watershed management is divided into three activities: planning, implementation and monitoring in which some institutions is responsible for specific activities. The plan is developed sectorally and administratively. The master plan of Serayu watershed is hoped to be a policy umbrella for those sectoral policies. In implementation In implementation stage, the programs is done for utilizing space in the watershed based on the dynamic change of social value, land price and natural resources, legal status, environmental impact, and regional development. In monitoring stage, the supervision and law enforcement on land use are the key components.

The basic principles in Serayu watershed management are: integrated plan and management in hybrid policy style, multidisciplinary and interdisciplinary, and multi region. Based on these principles, the scenario in institutional design in Serayu watershed can be described in the **Table 5.5.** and **Figure 5.10.**

Table 5.5 The institutional management functions in each management stage in Serayu watershed

Management Function of Stakeholders in Serayu Watershed			
Coordinative	Planning	Implementation	Monitoring and Evaluation
Province			
Planning Board, Environmental Agency, Legislative	Planning Board, Environmental Agency, Forest Agency, Irrigation	All government agencies; main agencies: agriculture, forestry, irrigation, law enforcement actors	Planning Board, Environmental Agency, Legislative, Related Agencies, NGO, Universities
Regency			
Planning Board, Environmental Agency, Regional Secretary, Legislative	Planning Board, Environmental Agency, Forest Agency, Irrigation	All government agencies; main agencies: agriculture, forestry, irrigation, law enforcement actors	Planning Board, Environmental Agency, Legislative, Related Agencies, NGO, Universities

Source: EACJP (2003)

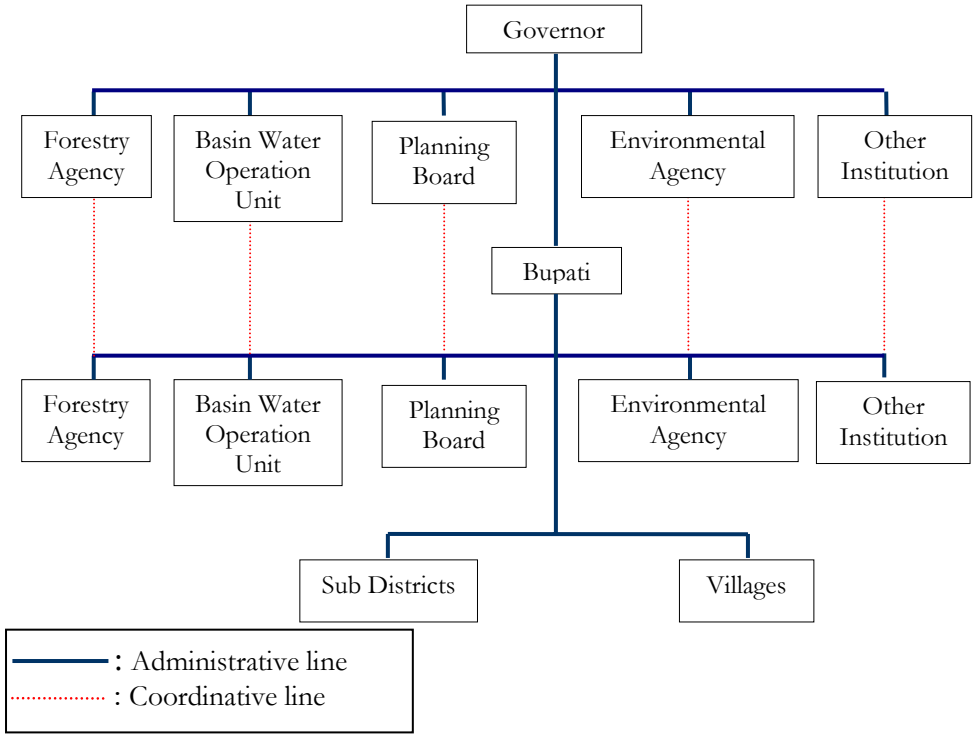

Figure 5.10 The institutional setting in Serayu watershed management
Source: EACJP (2003)

From **Table 5.5** and **Figure 5.10** above, the organization of Serayu watershed is emphasized on the coordination among actors involved with the clear job division among actors. The effective watershed management is shown in how the organization do its job based on the existing policies, while the efficient management of watershed organization is shown in how the organization uses the resources in achieving its goals. The institutional design above seems promising to have the effective and efficient management of watershed organization. The clear job division of stakeholders will reduce the overlapping of resource usage that is efficient for the organization, which also indicates the sustainability concept is applied.

Agreement among Actors Involved

As a result of the high environmental degradation in Dieng tourism area, this is located in the Serayu watershed, the agreement between Wonosobo and Banjarnegara regency is signed in 2002 (Kompas, 2 August 2002). This agreement focuses on the high soil erosion occurred in the area resulted from the intensive potato agricultural area and the illegal logging on conservation area. The annual erosion rate in Merawu tributaries is 9.6 mm/year much higher than the total Serayu watershed erosion rate 4 mm/year. This high soil erosion will shorten the life of Sudirman dam providing irrigation and hydropower services. In the past, the agreement merely focused on the tourism management and the profit division from the tourism area, which emphasized on economic dimension.

In addition, the community based forest management in Wonosobo regency stated in Perda 22/2001 has also an indication of the public participation on forest management and agreement between forest farmers and local government (Arupa, 2003). These agreements can also be seen as a way towards sustainable watershed management.

Strategies in Spatial Planning

The spatial plan developed is to accommodate the environment, social, economic and institutional strategies related to space. The key issue is how to make local government refer to the master plan of Serayu watershed which emphasizes more on environmental issue. As described above, the strategies in dealing with environment, social, economic and institutional basically give high portion on environmental consideration. The strategies in spatial planning can be depicted below:

- Firming spatial planning, conservation function to give regulation framework about spatial development. The existing of conservation area is the main issue in Serayu watershed. Therefore, the endorsement of conservation of area in a regulation can guarantee the ecosystem function in the watershed. This strategy is fully focusing on the conservation area for the ecosystem function which is very important in ensuring the long lasting environmental function for future generation. This strategy will be effective only if the law enforcement on land use is strong.
- The improvement of law enforcement which gives punishment for encroachments. The encroachment in land use will be given enough punishment, thus the existence of conservation area in the watershed can be guaranteed.
- Reducing spatial conflict through appropriate regulation. The strong government with its regulations can reduce the spatial conflict which is dangerous for the environment.

In general, the strategies in spatial planning contribute to achieve sustainability in watershed context as a reference for spatial planning developed by each local government. The important issue in spatial planning is the law enforcement which gives punishment for encroachments, thus the spatial planning made is implemented appropriately. The suit land use planned by the government referring to the Serayu watershed management plan will ensure the sustainable development.

5.6 Concluding Remarks

The sustainability assessment conducted in this research elaborates the general strategy of Serayu watershed management including vision, missions, and targets based on SWOT analysis developed to identify internal and external factor of development. The clearly defined vision and missions in the master plan indicates the sustainability concept is applied in the watershed. But, the targets defined are still broad and there is unclear time target. It can be an obstacle in achieving sustainability.

The environment indicators used for this research are: the budget allocation on environment, percentage of agricultural and forest area, and the quality and quantity of water. The budget allocation on environment indicates the strong effort of local government to give concern on environment that in turn can stimulate sustainable development. The percentage of agricultural area is relatively high indicating the food security of the area. But, the percentage of forest area is low indicating the less optimized forest function on hydrology. The quality of water assessed by TSS, BOD, and COD indicates the pollution on water that need to be addressed. The quantity of water is relatively abundant. The strategies on environmental aspect have fully adopted the sustainability concept.

From social aspect, the indicators developed are poverty, education, and population growth. The poverty level is very high indicating the other related problems such as powerless, isolated, pervasive and other systematic problems such as insecure livehoods, malnutrition and poor health, illiteracy, civil insecurity and corruption. It also can exaggerate the land degradation. Education level in average is still low (90, 69% only have basic education). It is a serious problem to be solved in achieving sustainable development. In contrary, population growth is 0.97% indicating the very low population growth that is good indication in sustainable development. The strategies developed in dealing with social dimension indicate that master plan does not entirely apply sustainability concept from social point of view.

The sustainability indicators in economic aspects are GDP per capita, economic structure, and economic growth. The average annual income depicted in GDP per capita in Serayu watershed is lower than national income, which is not good for sustainable development. The economic structure is dominated by agricultural sector (primary sector) in the upper and service (tertiary sector) in the downstream. This structure commonly occurs in many watersheds. The economic growth in regencies in Serayu watershed in average is 3.69% lower than national growth 4.8%. The strategies in dealing with economic problems have indicated the sustainability concept applied in the watershed.

The institutional indicator the establishment of national strategy on sustainable development is fulfilled. Indonesia has already had a national strategy on sustainable development. Moreover, some policies related water sand sustainable development support the national strategy on sustainable development, for example the Portfolio of Water Actions, Government Regulation No 82/2001, and Ministerial Decree No. 15/M-EKON/12 2001. The clear division of the management in the watershed has also indicated that the master plan has an effort toward sustainable watershed management. Agreement among local governments in dealing with a development issue particularly related to water is also an indication of the sustainability concept is being applied.

In general, from the indicators tested in the Serayu watershed, it has not fully fulfilled the sustainability concept yet. The integration horizontally and vertically in the watershed have been indicated in the watershed master plan. Policies, programs, and projects planned by local government are recommended to refer to the master plan. In addition, the one institution which is responsible for the watershed development is not existed yet. The existing join forum, a coordination and cooperation forum among local governments, is not really effective in dealing with sustainability concept in the watershed due to the main focus of the local

government recently is in economic rather than other aspects since decentralization era. The institutional design as described in the analysis will only effective if there is a strong commitment from all stakeholders. The master plan has indications in the way toward sustainable watershed management though its strategies in dealing with environment, social, economic and institution.

Chapter 6 Conclusions and Recommendations

6.1 Conclusions

Due to the more concern on the limitation of resources used for development fulfilling the humans' need achieving quality of life, and also the concern on next generation quality of life, some world agreements have been held. One of these agreements is the concept of sustainability. The concept of watershed management as a management unit for water has also become consensus for the last twenty years for many countries, including Indonesia.

This research is about the application of both "sustainability" concept and "watershed management" concept in a certain area (Serayu watershed). To assess the sustainability concept is applied in a certain watershed area, the sustainability assessment, consisting the criteria and indicators, is developed based on the ideal and legal criteria and indicators as described in chapter 3. The main reason of the selected indicators is the availability of data. The criteria and indicators of sustainability are tested on the master plan of Serayu watershed. Then, the research questions are answered in the following paragraphs.

What are the criteria and indicators of sustainable watershed management in theoretical view?

The development of criteria and indictors for sustainable watershed management starts with collecting the literatures relevant to sustainability concept. The ideal indicators of sustainability used are based on international agreement on indicators of sustainable development. These indicators are assumed to be ideal because many countries have agreed and they are supported by strong scientific background. In the case study of Indonesia, the legal indicators for watershed performance are endorsed in the Ministry of Forestry decree No. 52/2001. Both ideal and legal indicators can be clustered into four dimensions: environment, social, economic and institutional.

The criteria for the assessment are the same as the dimensions of sustainability: environmental, social, economic and institutional. In environmental criterion, the indicators selected are the budget allocation on environment indicating the willingness of each local government to deal with environmental issue, the percentage of agricultural area and the percentage of forest area indicating the carrying capacity of the watershed, and the quantity and quality of water indicating the health of the watershed that focuses on present and future environmental problems. In social criterion, the indicators selected are poverty level, education level and population growth. These indicators indicate the social conditions of a watershed related to water mainly how social issue can affect and be affected by the watershed. The main goal of social indicators is to get indications for the social sustainability achievement defined as "one that can persist over generations, one that far seeing enough, flexible enough, and wise enough not to undermine either its physical or its social system support" (Meadow and Randers, 1991). In economic criterion, the indicators selected are GDP per capita, economic structure, and economic growth.

These indicators indicate the individual and social 'well being' at present. While in institutional criterion is indicated by the existence of national sustainable development or related policies, a clear job division from each institution related to watershed management and agreement among local government within watershed.

How does government cope with environmental, social and economic issues in watershed context related to sustainability?

The government addresses issues of environmental, social and economic in watershed context by problems based approach. The SWOT analysis is done in order to develop general strategy through appropriate vision, missions, and targets based on local condition. This general strategy developed in the Serayu watershed master plan has fulfilled the sustainability concept indicated by the clear vision, missions and targets. But, the unclear time of achievement in targets indicate the less sustainable management of the concept to be applied.

In general, the strategies in dealing with each criterion of sustainability developed in the master plan of Serayu watershed have fulfilled the sustainability requirements. For example, the environmental strategy has adopted the sustainability concept indicated by its emphasis on more utilization of the renewable resources, minimizing the use of the resources and the environmental rehabilitation, which focuses not only for present generation but also the future. The social strategies in general have also adopted the sustainability concept manifested in the participation stimulation and partnership. Nevertheless, the education is not specifically described in the strategies. The economic strategy focuses on optimal use of natural resources and forest conservation. The extension of job opportunities not only on agricultural sector but also on secondary and tertiary sector indicates the sustainability concept applied. The existence of the national sustainable development strategy in Indonesia is an indication of sustainable development in Indonesia. Moreover, the clear job division based on each function of management in Serayu watershed indicates the sustainable institutional on watershed management. There is also an effort in achieving sustainability in watershed context through the institutional design for effective and efficient watershed organization.

What lessons can be learned from such practices in coping with applying "sustainability" concept in watershed context?

After discussing the first two research questions above, there are some lessons can be drawn. *First*, due to the unclear and fuzzy concept of sustainability, the effort of making it clearer based on the local perception is an important thing. Criteria and indicators of sustainability are referring to this effort by measuring the indications of the sustainability in some criteria.

Second, the local spatial plan should refer to the master plan of watershed in which all programs and projects in the administrative area focuses not only for the area but also consider the impacts on other area within the watershed. The empowerment of society as an effort of improving the quality of society particularly related to environmental concern will be done simultaneously with the economic stimulation. Thus, the balance between social, environment and economic managed by the appropriate institution can be achieved.

Third, the minim of data in developing sustainability indicators can be seen as an obstacle in assessing sustainability. This condition will limit the comprehensiveness of the results of the assessment. But, the selection of appropriate essential indicators is one way to achieve both sustainability and efficient assessment.

Forth, I argue that the indicators defined in this research can be used for the assessment for sustainable watershed management not only for watersheds in Indonesia, but also in other similar cases in the world. All dimensions in sustainability concept have been adopted, and some significant indicators have been selected based on scientific argumentations.

6.2 Recommendations

Further researches

The further study on sustainability indicators for assessing the sustainable development in other cases is still needed to enlighten the field of the debate. The efforts on searching the appropriate indicators for specific case can give better understanding on the sustainability concept to be applied in similar cases. The simpler data, I argue, is also important due to the efficiency reason. For example, the existence of particular species in a water ecosystem can be used for the indication of water pollution. In my opinion, the more complete of indicators to be tested, the better the result of evaluation will be due to its comprehensiveness. But, the fewer indicators which at least reflect sustainability is also appropriate in the case of lack of data availability.

Other relevant further research is the quantitative approach of sustainability in which each indicator in each criterion is weighted. It will give easier understanding on whether the plan, program or project is sustainable or not. As also been done by several scholars, the quantitative assessment through models in specific case regarding important variables is also interested to be researched. For example, the quantification of environment particularly water in economic term in Indonesia is important to internalize the externalities of environmental impacts. I argue that the combination method for sustainability assessment, the quantitative and qualitative approaches, can achieve more comprehensive result.

The unclear and ambiguous term of sustainability even has been researched for years remain the complexities of the area. Therefore, the researches on making this term clearer on specific case can contribute to the science. The complexities theory as described in de Roo's book (2004) can be used as the basic insight of the complexity of sustainability. I believe that sustainability concept is reliable concept to be used for development, thus the attempts in achieving it to be applied is important.

As a relatively new in applying decentralization concept in which each local government has bigger authority for managing its area including natural resources, local governments in Indonesia commonly extract their natural resources to get maximum local income. The watershed as a system will be influenced by this issue. The comprehensive research on this topic is also relevant recently to get better understanding of the issue. I agree that the delivering authority from central to local government together with promoting participation and empowerment of local community will strengthen the application of plans, programs, and projects. But, the

commitment of each local government to cooperate and coordinate particularly in environmental issue is a prerequisite for the implementation.

The research on the best management practice that is important for the import concepts such as sustainability, watershed management, decentralization and so forth are also essential due to the different context of the study. The careful adoptions from the results of the study regarding the context are also significant.

Finally, the needs of reliable information system related to watershed and sustainability to reduce bias in conducting researches related to water management is crucial. The research on reliable information system in which the information can be available for everyone shall stimulate the better discussion room for everybody in making the better sustainable water management in the future, particularly from scientific point of view.

For local governments

Local governments within watershed should refer their spatial plans to the master plan of the watershed to integrate the policies, programs, and projects of each local government in order to achieve the watershed management goals and objectives as stated in the master plan, which implies the adoption of sustainability concept. It requires the strong coordination and cooperation among local governments. Local government is also responsible for the empowerment of the society due to the lack of capability of participation. The capacity building programs should be simultaneously done with the physical developments.

.

Reference

_____. 2001. The Indonesian Ministry of Forestry decree No. 52/2001. The Guidance of the Management of Watershed (In Indonesian). 23 February 2001.

_____. Ministry of Forestry Decree No 52/2001. Government of Indonesia

Allouche, J. and M. Finger. 2001. Two Ways of Reasoning, One Outcome: The World Bank's Evolving Philosophy in Establishing a "Sustainable Water Resouces Management". Policy. Global Environment Politics. Massachusetts Institute Technology.

Arupa et al. 2003. Decentralizing Natural Resource Management: Collaborative initiatives between Local government and Local Communities. Non-Timber Forest Products – Exchange Program, Voluntary Service Overseas Philippines, Environmental Science for Social Change.

Asdak, C. 2002. Hydrology and Watershed Management. (In Indonesian). Gadjah Mada University Press. Yogyakarta.

Astleithner, F. and A. Hamedinger. 2003. The Analysis of Sustainability Indicators as Socially Constructed Policy Instruments: Benefits and Chalenges of 'Interactive Research'. Local Environment, Vol. 8, No. 6, pp 627-640. Carfax Publishing.

Bandaragoda, D.J. 2000. A Framework for Institutional Analysis for Water Resources Management in a River Basin Context. Working Paper 5. International Water Management Institute.

Bencala, K., R. Hains, E. Liu, T. Nogeire, D. Segan, and S. Stevens. A Framework for Developing a Sustainable Watershed Management Plan for San Cristobal de Las Casas, Chiapas, Mexico. Master's Thesis. University of California, Santa Barbara.

Bhat A., K. Ramu, and K Kemper. 2005. Institutional and Policy Analysis of River Basin Management. The Brantas, River Basin, East Java, Indonesia. Policy Research Working Paper.. The World Bank.

Blomquist, W. and E. Schlager. 2005. Political Pitfalls of Integrated Watershed Management. Society and Natural Resources. Taylor and Francis Inc.

Bossel, H. 1999. Indicators for Sustainable Development: Theory, Method, Applicatons. A Report to the Balaton Group. International Institute for Sustainable Development. Retrieved on June 16, 2006, from http://www.transportes.gov.br/CPMA/IndSustDesenTMA.pdf

Brooks, K.N. and K. Eckman. 2000. Global Perspective of Watershed Management. USDA Forest Service Proceedings RMRS, p 11-20.

Buckhingham-Hatfield, S. and B Evans. 1996. Environmental Planning and Sustainability. John Wiley and Sons.

Commission of the European Communities (CEC). 2005. Sustainable Development Indicators to monitor the implementation of the EU sustainable development strategy Communication from Mr. Almunia to the Members of the Commission..

Commission on Sustainable Development (CSD). 2001. Indicators of Sustainable Development: Guidelines and Methodologies. United Nations Commission on Sustainable Development. Retrieved on 11 July 2006 from: http://www.un.org/esa/sustdev/publications/indisd-mg2001.pdf

De Roo, G., G. Porter. 2004. Fuzzy Planning, Faculty of Spatial Sciences, Groningen, The Netherlands

Department of Irrigation and Drainage. 2006. *Serayu River Basin, Central Java, Indonesia*. Retrieved on August 2nd, 2006. http://htc.water.gov.my/apfriend/eLibrary/Catalogue_of_rivers/Volume_3/kali_serayu.pdf

Dicke, Willemijn. 2001. Bridges and Watersheds: A Narrative Analysis of Water Management in England, Wales, and the Netherlands. Amsterdam: Aksant Academic Publisher.

Dolowitz, D. and Marsh, D. 1996. Who learns what from whom: a review of the policy transfer literature. Political Studies, XLIV, p. 343 – 357. Blackwell Publisher.

Eckerberg, K. and E. Mineur. 2003. The Use of Local Sustainability Indicators: case studies in two Swedish municipalities. Local Environment, Vol. 8, No. 6. pp 591-614. Carfax Publishing.

Environmental Agency of Central Java Province. 2003. Environmental Grand Design of Serayu Watershed Management. EACJP. Indonesia

Foxon, T.J., M. Leach, D. Butler, J. Dawes, D. Hutchinson, P. Pearson, and D. Rose. 1999. Useful Indicators of Urban Sustainability: some Methodological Issues. Local Environment, Vol. 4., No. 2. Taylor & Francis Ltd.

Goldfarb, William. 1994. Watershed Management: Slogan or Solution? Boston College Environmental Affairs Law Review, 0190-7034, March 1, 1994, Vol. 21, Issue 3 .

Grigg, N.S. 1996. Water Resources Management. Principles, Regulations, and Cases. Mc Graw Hill.

Hall, et al. 2000. Quantifying Sustainable Development: The Future of Tropical Economies. Academic Press. USA

Healey, P. 1997. Collaborative Planning: Shaping Places in Fragmented Societies. Palgrave Macmillan. New York.

Heathcote, I.W. 1998. Integrated Watershed Management: Principles and Practice. John Willey and Sons. New York.

Hijri and Ibrekk . 2001. Environmental and Water Resources Management. Environment Strategy Papers No. 2. The World Bank. USA.

Hoekstra, A.Y. 1993. A Scientific framework for the Planning of Sustainable Water Resources Management. Research Report. International Institute for Applied Systems Analysis. Delft Hydraulics.

Houterman, J., M Djoeachir, R.H. Susanto, and F van Steenbergen. 2004. Water Resources Management During Transition and Reform in Indonesia: *Toward an Integrated Perspective on Agricultural Drainage*. Agriculture and Rural Development Working Paper 14. The World Bank

Ice, G., R. Kolka, and D. Gilmore. 2005. Hydrologic Functions of the Riparian Forests. Retrieved on 14 July 2006 from: www.state.mn.us/ebranch/frc/FMgdline/Hydrology_paper.pdf

Janson, B.O. and C.E., Stalvant. 2001. The Baltic Basin Case Study – Towards a Sustainable Baltic Europe. Continental Shelf Research 21. 1999-2019. Pergamon.

Koontz, T.M. 2006. Collaboration for sustainability? A framework for analyzing government impacts in collaborative-environmental management. Sustainability: Science, Practice and Policy. Spring 2006. Volume 2. Issue 1

Lee, R.G. 1992. Ecologically effective social organization as a requirement for sustaining watershed ecosystems. Watershed management: balancing sustainability and environmental change. Springer – verlag. New York.

Livingston, M.L. 1995. Designing Water Institutions: Market Failures and Institutional Response. Water Resources Management 9: 203-220.

Lorenz, C.M., A.J. Gilbert, and W.P. Cofino. Environmental Auditing: Indicators for Transboundary River Management. Environmental Management Vol. 28. No. 1, pp. 115-129. Springer-Verlag. New York.

Martens, P. 2006. Sustainability: science or fiction? Community Essay. Sustainability: Science, Practice and Policy. Volume 2, issue 1.

Meadow and Randers. 1991. Beyond the Limits. Classics in Environmental Studies. An overview of classic texts in environmental studies. 1997. International Books.

Moss, T. 2003. The governance of land use in river basins: prospects for overcoming problems of institutional interplay with the EU Water Framework Directive. Land Use Policy 21 (2004), p. 85 – 94. Elsevier.

Naiman, R.J. 1992. New perspectives for Watershed Management: Balancing Long-Term Sustainability with Cumulative Environmental Change. Springer-Verlag. New York.

Pope, J., D. Annandale, and A. Morison-Saunders. 2004. Conceptualizing sustainability assessment. Environmental Impact Assessment Review. Elsevier.

Rahaman, M.M., O. Varis & T. Kajander. 2004. EU Water Framework Directive vs Integrated Water Resources Management: The Seven Mismatches. Water Resources Development Vol. 20, No. 4, pp 565 – 575. Carfax Publishing.

Roberts, P. 2006. Evaluating Regional Sustainable Development: Approaches, Methods, and Politics of Analysis. Journal of Environmental Planning and Management. Vol. 49, No. 4, 515-532. Routledge.

Rydin, Y., Nancy Holman, and Esther Wolff. 2003. Local Sustainability Indicators. Guest Editorial. Local Environment, Vol. 8, No. 6, 581–589. Carfax Publishing

Serbulea M. and C. Tortajada. 2003. Conference Reports. Workshop on Reassessment of the Sustainability Paradigm for the Water Sector, 7-8 August 2002, Bibliotheca Alexandrina. Water Resources Development. Vol. 19, No. 1, 103-111. Carfax Publishing.

Spangenbarg. J. H. 2004. Reconciling sustainability and growth: criteria, indicators, policies. Sustainable Development 12, p. 74-86. Wiley Inter Science.

Tyson, J.M. 2000. Quo vadis – Sustainability? North West Water, Dawson House Great Sankey, Warrington WA5 3LW UK

UNDESA._____. Governing Water Wisely for Sustainable Development. The 1st UN World Water Development Report: Water for People, Water for Life. Retrieved on June May 8, 2006 from http://www.unesco.org/water/wwap/wwdr/pdf/chap15.pdf

UNDSD. 2001. The CSD Work Programme on Indicators of Sustainable Development. Working Paper No. 27. Joint ECE/Eurostat Work Session on Methodological Issues of Environmental Statistics. Ottawa, Canada, 1-4 October 2001. Retrieved on 10 July 2006 from: http://www.unece.org/stats/documents/2001/10/env/wp.27.e.pdf

UNECE._____. Signing Progress: Indicators Mark the Way. The 1st UN World Water Development Report: Water for People, Water for Life. Retrieved on June May 8, 2006 from http://www.unesco.org/water/wwap/wwdr/pdf/chap3.pdf

UNEP. 2004. Integrated Watershed Management. Ecohydrology and Phytotechnology. Manual. UNEP, UNESCO, IHP.

Watershed Management Technology Center (WMTC a). 2004. The Study of Watershed Characteristics in Java and Sumatra. (In Indonesian). WMTC. Indonesia

Watershed Management Technology Center (WMTC b). 2004. Institutional Model of Watershed Management in Central Java, Yogyakarta, and East Java. (in Indonesian). WTC. Indonesia

Wikipedia. 2006. Common Goods. Retrieved on 20 July 06 from: http://en.wikipedia.org/wiki/Common_good_%28economics%29

Woltjer, J.N., N.Al (2006) Towards a strategic approach to regional water planning in Europe; paper presented at the 2005 ERSA Conference, Amsterdam

World Bank. 2001. Indonesia: Environment and Natural Resources Management in a Time of Transition.

WWF. 2001. Elements of Good Practice in Integrated River Basin Management. A Practical Resource for Implementing the EU Water Framework Directive. Key Issues, Lessons Learned and 'good practice' examples from the WWF/EC "Water Seminar Series" 2000/2001.

- Bernas, 11 July 2002. Debit Air Sungai Serayu Menyusut, PLTA Mrica Terancam Mati (*Water Discharge is decreasing: Mrica Hydro Electric Power is threatened*). Retrieved from http://www.indomedia.com/bernas/072002/11/UTAMA/11jat2.htm on 10 February 2006
- Kompas, 2 August 2002. Perjanjian Kerjasama itu sangat mahal (*The Aggreement is too Expensive*). Retrieved from http://www.kompas.com/kompas-cetak/0208/02/jateng/perj25.htm on 10 February 2006
- Suara Pembaruan, 8 August 2003. Waduk Sempor dan Wadaslintang Kritis: Ribuan Hektare Sawah Kekeringan, 675 Puso (*Sempor and Wadaslintang Dams are in critical condition: Thousands of Hectares Sawahs Drought, 675 Failed*). Retrieved from http://www.suarapembaruan.com/News/2003/08/08/Nusantar/nusa02.htm on 10 February 2006