ECOSYSTEM APPROACH:

ECOLOGICAL FUNCTIONS OF FORESTS

IN A HUMAN-DOMINATED AREA

CASE OF THE BENGAWAN SOLO RIVER BASIN, JAVA – INDONESIA

DISSERTATION

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1. Introduction

1.1. Ecological problems

Ecology and environmental science are closely related disciplines. The difference between them is: environmental science focuses on the natural environment of humans, and ecology science is usually focussed on how organisms interact with each other and with their immediate surroundings. Environmental science is a more overarching field that incorporates many elements of earth and life sciences to understand various natural processes. In this context ecology could be considered a subset of environmental science.

In common usage, environmental science and ecology are often used interchangeably. Thus, ecological problems are commonly considered identical with environmental problems. Although ecology is part of environmental science, ecology is more concerned with the interconnection between its components; the interaction between living organisms and their environment. Interconnections among the components of an ecological system are multidimensional, which often complicates the process of finding the right answers to ecological problems because too many factors must be considered to find potential solutions. Hence ecological problems in many cases cannot be solved without political support. Ecology as a scientific discipline can offer solutions but politics must decide about the final decision. Unlike ecology that is guided by scientific approaches, politics is more a question of interests and power which prevents quick solutions to ecological problems. This is the main reason why today's ecological problems have become such a big challenge. What kind of challenges to the development policy and the management of a country like Indonesia are posed by the current ecological problems?

The developing countries in Asia had the distinction of becoming the fastest growing economy of the world. Indonesia was one example of these tiger economies that enjoyed rapid economic development until the economic crisis hit in 1997. But prior to the crash, economic growth was used as the main indicator of the development success of Indonesia. Prior parameters of development success such as economic growth rate can only indicate the increase in national wealth or the reduction in poverty, not life quality. A significant portion of the Indonesian economic revenue was particularly connected to the natural exploitation of natural resources, such as in the forestry sector. This is which is usually associated with detrimental effects on the environment. Yet environmental impact assessment is only limited to the course of projects whereas long-term impacts are not well considered. For examples, land use conversion has resulted in the fragmentation of natural habitats, which contributes to the loss of countless wild species; timber exploitation has also destroyed most natural habitats. Wide areas of natural forests and other ecologically

important areas in Indonesia have been replaced by plantations, cultivations, settlements and infrastructure systems. Industrial growth has accelerated further the environmental degradation, for instance, water and air pollution. In general, policies that have prioritised economic growth without considering the environment and its recovery were not able to maintain the quality of living of organisms and mankind automatically. Such kind of development policy has for sure been detrimental to the environment and livelihoods of the local people.

Beside 'unwise' ecological policies, high population density as well as poverty have contributed significantly to shaping the environment in Asia including Indonesia (WRI 2003). Land conversion into non-productive uses has historically been emphasized to accommodate population growth and it is a particular cause of ecosystem imbalance. Major environmental impacts are associated with the rapidly growing population like increased pressure on the conversion of arable land to human settlement, land clearing for cultivation, intensive agriculture for intensified food production as well as overgrazing. In the Indonesia history, there is a strong correlation between population growth and land use change including an increased rate of deforestation. In addition, the trend to select areas as ecological pools and protected areas tends to be limited in size and it is necessary to examine if their existence can preserve ecological stability or not. Main negative impacts to the environment include erosion, drought, flood, landslides, as well as clean water scarcity, species extinction and pollution (Smiet 1989; World Bank 1990; Whitten *et al.* 1997; Silalahi 2001). Java mirrors (in many respects) those kinds of inappropriate development. Tailoring them to the forestry sector and forest functions arrangement should be interesting, since Java is the development hub for other islands in Indonesia.

One important issue that resulted in the current condition is the lack of cooperation between different sectors which are potential powerful drivers of change concerning land use. One example is the transportation sector which is one of the key factors in development to accelerate economic growth. Road infrastructures, including bridges, open up the remote areas, divide the natural area into fragments and in particularly affect sensitive species negatively. In many areas that have been urbanized, a relatively high concentration of road networks and vehicles has resulted in high levels of air, water and soil pollution due to various emissions. Between 1975 and 1988, the developing countries in Asia witnessed broad-based increases in manifold pollution, namely water pollution (Biological Oxygen Demand and suspended solids), air pollution (SO_x and particulates), and toxic waste (a composite index of various toxins emitted into the air and water, in addition to solid waste and heavy metals). In this respect, environmental problems have become health hazards. But in a broader sense, environmental degradation affects the general quality of life (ESCAP 1995) and they cause problems in development (Brandon and Ramankutty 1993). Mukherjee

et al. (2002) summarize how the lack of management capacity to preserve or maintain environmental resources in developing countries (like in Asia) can be identified as one of the main constraints. Such incapability is mainly due to institutional barriers, inappropriate services, indifference, corruption, and exploitation.

According to the Millennium Ecosystem Assessment Reports (2005), the human well being and progress toward sustainable development depend on better management that can ensure nature conservation and sustainable use of natural resources. The expectation of better management is that policy and management intervention can reserve ecosystem degradation and enhance the contributions of ecosystems to human well-being. Forestry is one sector that has a clear responsibility to maintain the ecosystem. It is extremely necessary to balance the diverse requirements, demands and claims of development with their ecological risks and consequences because the causes and impacts of ecological problems re-emerge as societal problems. An integrated policy and management is important for sustainability. The question is how this can be achieved and how the Indonesian forestry sector engages under the above mentioned circumstances?

1.2. Concepts and Challenges for the Indonesian Forestry Sector

Indonesia has ratified various international agreements and takes part in international conventions for the environment. In summary, the national policy has adopted some important global agreements that are expected to support the country's development. Transition to ecological stewardship has, at least, commitments at the national level, but it needs further specification and practical initiative at the regional and local level.

In general, a policy adjustment is a common tool in a development process when the current policy does not comply anymore with the development in the society or social change. In the land use and forestry sector, it is not only linked to ecological stewardship but also has to pay attention to biodiversity aspects carefully.

Biodiversity is seen as an essential and thus an important indicator for ecosystem functioning and integrity, including anthropogenic ecosystems. Therefore to maintain or increase ecological functions or to combat ecological problems, biodiversity has to be put as the basic consideration of the discussion. A particular question of this study is, whether the current Indonesian development policies and their respective management in the forestry sector do comply with the ecological goals regarding biodiversity down to the lowest level in the management system.

1.3. Ecosystem Management in Forestry

A tree, a group of trees or a forest stand can be multifunctional. However, a certain function is usually considered to be more important than other functions and it will affect the silvicultural treatment. Basically, the nature of forests can maintain the quality of environmental components, such as water table, water and air quality, soil fertility, biodiversity and forest type very well.

Interdependence between components within an ecosystem is one important key in defining unit-level of management. Various authors have delivered different approaches with different foci in this respect for instance ‘eco-regional approach’, ‘landscape approach’, ‘ecosystem approach’, ‘integrated catchments management’, ‘community-based natural resource management’ etc. Most of these approaches concur that ecosystem management requires to look at the big picture beyond administrative and sector’s boundaries and work closely together with both, public and private lands. From the social perspective, ecosystem management is seen as a social process that is driven by cultural backgrounds and the connection between local communities and their environment. From the ecological point of view, various interactive natural processes are found in an ecosystem and between ecosystems like geochemical, hydrological, thermodynamic and biological processes.

Professional disciplines or sectors should consider these aspects, but their view is often limited just by the value of the land and its economic potentials. However, land as an object of management requires a broad perspective to define boundaries, namely to consider the role of history. In this context, ecosystem management particularly by land use planners and developers usually lacks consideration of the broad range of the functions of an ecosystem in a given area: because the site and its pattern of ecological change is usually simply predicted in a narrow range, such as through demarcating clear boundaries by property or jurisdiction line, or predicting future events from current human policies and activities.

As a task, forestry and foresters, consequently, may need to improve and formulate what ‘ecosystem management’ for ecological benefits means. These processes provide utility to humans, such as flood control, water purification, and nutrient cycling which are also of economic relevance.

1.4. Ecosystem Management and Ecosystem Approach

The Ecosystem Approach (EsA) is a concept that was introduced by the Rio-Declaration of 1992 to promote biological diversity under the United Nation Convention on Biological Diversity (UN-CBD) in the sustainable development framework. However, its

principles and operational guidance have been endorsed just at the fifth Conference of the Parties in the year 2000 (CBD 2000).

Tracing back to the source of origin, EsA was developed from 'Ecosystem Management' that was developed in the 80's and gained a major impact on the development policy until 1996 in USA and Canada. These countries had promoted and pushed forward issues like landscape scale, decentralized management and effective public participation. In the beginning, the adoption of Ecosystem Management into EsA mainly focussed on biological diversity in forest management. However, the difference between both, EsA and Ecosystem Management, was vague, and both adopted the same strategy, namely integrated management. For that purpose, a series of workshops and meetings for an operational description of EsA took place since 1997 (Hartje *et al.* 2003).

According to Cortner and Moote (1999 in Hartje *et al.* 2003), the difference between EsA and Ecosystem Management lies in the objectives of their application. Ecosystem Management is seen as an approach that views nature pragmatically. Nature is seen as a bundle of resources that deliver economic goods and services and can be manipulated and harvested under human control. In this context, Ecosystem Management can effectively be used to underlie a 'project', which narrowly focuses on the management of ecological processes. Each sector can use this concept to underlay its own sectoral projects, but there has been no concept to integrate and join different perspectives. To fulfil this gap, EsA was promoted to accommodate the dynamics of ecosystems and the complex interwoven relationships of their components. Nature, as understood, in this context cannot be fully controlled by mankind and therefore protection of ecosystem attributes, such as biological diversity and the sub-systems are critical (Barbier *et al.* in Hartje *et al.* 2003). To aim at this task, EsA is needed for further development to be applicable not only on a specific scale but for all 'appropriate' scales (IUCN, PROFOR and World Bank 2004).

With respect to the complex interrelationship between nature and the human-system, EsA had to retain flexibility without ever losing its force for nature protection. The flexibility of EsA, particularly is shown when determining management scales are determined. By overlaying natural and juridical boundaries and protection-networks for all levels of protection areas are implemented. In this context, current integrated management under Ecosystem Management can serve as a compliment for EsA's application.

1.5. Critical views on the Ecosystem Approach in Forestry

Forest managers should be aware that their working areas are part of an ecosystem that contains complex sub-systems and uncertainties but also represents various values for people. In this respect, the ecosystem approach may play an important role as a preventive

measure to protect native biological diversity, including the unknown components. To safeguard the unknown components, it is more likely that EsA gives a broader perspective for forest management than the protection of desirable but selected species. Respectively, EsA could be an approach to improve current efforts concerning the conservation of biological diversity for future generations. EsA direction is to reduce the loss of biological diversity, including threatened species and yet unknown species, as well as to promote natural complexity and diversity that are very essential for ecosystem processes and functions. Unlike traditional ecosystem management, the EsA does not mean to enumerate and maximize the ‘’output’’, but rather to conserve the long-term ecological sustainability through allowing the use of ecosystem services in a sustainable manner. This approach is a fundamental shift of view from humans as exploiters to humans as stewards (Hartje *et al.* 2003).

There are 12 principles (Table 2.1) that are formulated as broad statements concerning a variety of different aspects that open a wide scope for interpretation (Schlaepfer *et al.* 2004). According to COP7-CBD (CBD 2004 a), the application of those principles needs to be considered in accordance with local conditions, including legislation. The implementation of other approaches in place, like ecosystem based management or integrated river-basin management etc. can be promoted as a complement.

Although EsA has been widely accepted, it has been realized that the elaboration of this approach needs to be translated into good operational practice (Hartje *et al.* 2003; CBD 2004 a).

In the forestry sector, the approach might compete with the established and widely implemented ‘’Sustainable Forest Management’’ (SFM). Due to its elaborated criteria and indicators, SFM is comparably mature from an operational standpoint. Various studies and reviews have been carried out to compare both approaches e.g. by IUCN, PROFOR, World Bank (2004), CBD (2004 a). In summary, EsA and SFM are not identical, but are similar in many respects. Both abstain from legal-binding allowing flexibility and experimentation, and both consider societal, ecological and governance issues. However there is still a clear need for the EsA to adopt processes that are based on a statement of visions, objectives and goals for defined regions or issues, to become more outcome oriented. In this sense, a cross-sectoral integration and mechanisms for inter-sectoral collaboration would be strengthening. Although there is no predefined scale, EsA is applicable to large areas (landscape level), while SFM emphasizes the forest management unit level. In some larger scale of applications like landscape restoration initiatives, SFM can also be applied within a broader spatial context, including protected areas by taking into consideration conservation issues in general and developing links to adjacent land use, although the Forest Principles do not indicate it. The application of EsA, however, depends greatly on the existing system in

the place, whether the nature of the applied management system or not to allow the linkage between forestry and other sectors such as water management, transport, agriculture, conservation etc. On the other hand, the application of EsA might help both to deal with complex issues such as law enforcement, land tenure rights and the right of indigenous and local communities. Thus, EsA, which does not focus on production like SFM does, encompasses other priority functions of forests, particularly for ecological functions.

1.6. Problem Statement and Structure of the Study

1.6.1. The Challenge for the Indonesian Forestry Sector to apply the EsA

Severe environmental disasters happen repeatedly throughout Indonesia, for example, landslides, floods, lack of fresh water, clean water scarcity etc. Usually forestry aspects have been seen as the main factor of such accidents. This kind of simplicity often raises trouble for the forestry sector. Such issues usually relate to forest degradation due to intensive land conversion that might lead to decreasing natural resilience and environmental quality. Within the forestry sector, issues like habitat loss for various rare plants and wild animals, or fragmentation of natural areas into much smaller patches have been understood as results of habitat isolation. Low watershed quality and fragile environments have caused various disasters. The quality of life has also declined due to air pollution, over-heating etc. as an effect of environmental imbalance. Pollutions usually are originated from industry, agriculture, home activities and transportation. Simple attribution to the forestry sector as the sole actor with responsibility for maintaining the ecosystem is certainly inadequate. The Government of Indonesia recognized that all development sectors have responsibility. Each sectoral contribution with an elaborated concept how to maintain ecosystems in development needs to be studied. But there are few studies that tailor those issues, particularly at the management level, across sectors and in the frame of integrated management.

Since early 2003, Indonesia's forest policy has committed to an 'ecosystem approach'. This approach has been determined by the Ministry of Forestry (MoF) through a decree No. 342/2003 on Strategic Planning of the Forestry Department. However, the Ministry of Environment (2009) in the Indonesian Biodiversity Strategy and Action Plan has reported that the achievement is not yet clarified, although the ratified UN-CBD of 1994 has entered into force through Law No. 5/1994.

Although the application of EsA's principles is voluntary or non-legally binding, the challenge is to identify the conceptual constraints concerning their application and integration into the referring management system as well as to estimate what consequences will be with the current practices.

1.6.2. Aims, Objectives and Questions of the Study

The aim of this study in general is to support forestry, particularly forest management, related to the committed ecosystem approach. This includes:

- to learn about ecosystem approach principles and their practical implementation through study cases;
- to support the current forestry concept based on the ecosystem approach;
- to identify the areas that are administered by the forestry sector and to assess the respective expertise and opinion of foresters ;
- to highlight the importance of forestry in any type of land development;
- to promote inter-sectoral collaboration, particularly from the forestry standpoint.

Accordingly, this study has four objectives, namely:

- To evaluate some cases of sectoral development policies and practices focussing on environmental management issues and ecological forest functions with the EsA principles as a normative background. The goal is to find out about challenges, to present the relevant knowledge of the respective disciplines, to emphasize legal-instruments and to present conservation experiences.
- To position forestry in development. The EsA principles are basically focussed on biodiversity means. Nonetheless they might also be seen as a concept that enables the initiation and promotion of forest enhancement. In this respect they might act as a challenge in areas where the forest has been fragmented and has shrunk to small and degraded remainders due to agricultural and urban development. This involves cross-sectoral development issues. Thus, understanding the general ecological context and key ecological components of the study area, including information about the regional conservation efforts are important. On the way around, the study is expected to explain to what extent the ‘ecosystem approach’ and its principles have been followed by the forestry sector.
- To reaffirm the management system in place, including its statutory support. The expected outcome is to explore the meaning of ecological functions of forests under Indonesian laws and to learn from practice examples shown in the case studies, how they are integrated in sectoral development.
- To position the role of foresters. Since the Ecosystem Approach is the new strategy that replaces the traditional one, the role of foresters might need to be extended and redefined.

In this respect, several case studies will be analysed on the basis of the following research questions:

(1) What is the substantial content of laws concerning ecological functions of forests and area management in Indonesia; what are the implications of those laws concerning the study site?

(2) What responsibilities have been taken by the forestry sector to improve ecological functions of forests in the study area?

(3) What are the consequences when EsA principles are applied by the forestry sector including collaboration with other development sectors and local communities?

(4) How does EsA intend to preserve the quality of the existing forests, and its biodiversity; how will it enhance the forest landscape and improve the environment quality for human's comfort?

1.6.3. Study Area and Case Studies

The Bengawan-Solo-River Basin (later: BS Basin), Java (Indonesia) was selected as the area for all case studies. The Basin lies in two provinces, Central- and East-Java, where natural habitat areas are extremely fragmented and minimized. Many species have been lost, and many other species have been reduced to unsustainably small and isolated populations that may soon disappear. Like other places in Java, the Basin has a high density of human population which resulted in expansive land conversion for settlement and agricultural use. Even the steepest slopes and the most remote areas have been opened-up by road network development and converted to urbanized areas.

In this area, six forestry related sectoral development projects and two reports about the area's development were chosen to investigate their ecological relevance concerning forest functions and to assess their strengths, weaknesses, opportunities and threats with regard to the EsA.

1.6.4. Structure of the Study

This study is structured into eight chapters, which are arranged in the following manner:

- **Chapter 1** provides an introduction and some background information concerning the issues of the study. This chapter also outlines the problem statement as well as the research aims, objectives and questions as basis for the following investigations.

- **Chapter 2** provides the theoretical and the conceptual framework which was necessary for the study. It encompasses the concept of ecosystem functions as the essential reason for management. The background of EsA and perspectives of environmental ethics are discussed to deduct the necessary actions to support forest functions. Chapter 2 further outlines differences between the two important views on forest management, namely EsA and SFM; and it discusses why the EsA approach is more suitable for this study. The EsA principles are portrayed literally as well as their correlation with the recent forest management.
- **Chapter 3** describes the research procedure and the methods used for the study
- **Chapter 4** presents first the existing legal system in place, including the hierarchy of legislations and a list of current regulations that determine ecological forest functions and their management. Then it provides the selected study cases that are related to the issues.
- **Chapter 5** provides the selected study cases that are related to the issues. Conclusions and recommendations to each case are also given.
- **Chapter 6** evaluates the EsA context in Indonesia's forest function management providing by a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis in order to answer the research questions and identify appropriate future management strategies.
- Finally **chapter 7** presents general conclusions that reflect the results of the evaluation and gives recommendations for future management.

2. Theoretical Framework

2.1. The Concept of Ecosystem Functions

The increasing destruction of nature through manifold utilization to fulfil the demands for food, fibre, and space for human settlements imposes increasing pressures on the world's ecosystems (WRI 2000). Practices such as arranging trees in rows to maximize future harvests or preserving only small areas for conservation purposes are obviously not considering impacts at ecosystem level and do lack ecological consciousness. Hence, paying attention to the ecosystem processes that constitute the habitat has become a major challenge in natural resource management. In this respect, particularly ecosystem processes that relate to biodiversity do matter (Scherer-Lorenzen *et al.* 2004).

2.1.1. Definition Concernings Ecosystem

An ecosystem is understood as a group of living organisms plus their non-living environment, including soil, water, nutrients, and climate. Forests, grasslands, deserts, and lakes are all examples of ecosystems. The term ‘’ecosystem’’ occupies a wide range of issues that involve the interrelationship between natural systems and human systems. To study them can cover an enormous range of scales, from molecules and microorganisms to entire landscapes as well as the human demands and requirements.

2.1.2. The Background of UN-CBD Ecosystem Approach

The concept of ecosystem approach had been widely used in the 1980s, especially in the United States of America’s fisheries. In the 1990’s, a consensus document how to manage ecosystems produced by the Ecological Society of America. It narrowly focused the management of ecological processes, but neglected social and economic diversity. Today, the concept is far more integrated and holistic and has become a management concept for entire ecological units. In the late 1980s, the United State Forest Service (USFS) adopted the concept. The subsequent principles of this USFS work were finally adopted by the UN-CBD (IUCN, PROFOR, World Bank 2004).

The development of the UN-CBD EsA principles relied on various lessons learned from the failure of prior approaches, like the concept of ‘’sustainable use’’ and ‘’sustainable yield’ of resources. Especially scientific information that had always been regarded as an important basis has a history of failures (Hilborn and Ludwig 1993). Although sustainability concepts did consider ecological values, their main concern was focussed on a single commodity like wood from one-, two- or multi-species stands. As a result, they did not determine nor take into account the ecological values as a whole.

Nowadays the global ecological awareness requires more nature- and environment-oriented development, such as, including the UN-CBD approach. As a consequence, further consideration and knowledge of ecological complexity, processes and functioning's are required. The fact that the environment is often enormously depleted, which impacts negatively on the total net value of the natural systems, works as one of the main driving forces.

2.1.3. Ethic Perspectives Concerning Ecosystem Management

The current ecosystem management understands ecosystem functions as the basis and target of management measures, although knowing little about how the ecosystem is really functioning, for example when it comes to the biota (biological diversity). However it is out of question that ecosystem functions are not only determined by natural i.e. by biotic and abiotic elements but also by socio-cultural elements.

The common goal of ecosystem management is to sustain these functions. To approach this goal, two different ethic obligations can be adduced, namely an anthropocentric and a biocentric or ecocentric perspective:

The anthropocentric perspective is seen as a human-centred approach that views issues in terms of human values and interests. The US Fish and Wildlife Service (1994) for instance defines it as the balance between utilities and natural resources; and the US Forest Service defines it as a multiple-use management of forests that is blending the needs of people and environmental values (Robertson 1992 in Moote *et al.* 1994). According to Godfrey-Smith (1992), such kind of obligation is a function of human interests, where the environment is deemed to have instrumental value.

In practice, the anthropocentric perspective delivers a mandate of control over ecosystem functions or values through sustainable resource development of nature for demands like tourism/ecotourism, aesthetic and spiritual welfare or for science and research. In cases like wilderness preservation the preserved areas might also be needed in the future for some currently unforeseen reasons. This perspective asserts that if to preserve an area is of human interest, this must happen through a political claim. Therefore an obligation to preserve or to protect wilderness areas is backed by policies, regulations and legislation (Godfrey-Smith 1992).

On the other hand, the anthropocentric perspective seems to be too limited to deal with wilderness areas, since they would not be preserved if not through humankind's own interest. Ecosystem management is obviously humanistic, because it is centred on human interests and claims that effective stewardship mandates ensure and control our multiple demands for

resources, stable local economies, recreation, biodiversity or ecosystem integrity (Ehrenfeld 1981).

According to Grumbine (1994), the biocentric perspective views ecosystem management as an integration of scientific knowledge about ecological relationships into a complex socio-political and value framework to follow the general goal of protecting native ecosystem integrity over the long term. Compared to the anthropocentric perspective, this definition does not concern the human use, but rather puts organisms and ecosystems at the centre. The (moral) obligation is directed towards life and nature such as to the community of living things combined with non-living things. According to Godfrey-Smith (1992), the environment is deemed to have intrinsic value i.e. value for its own sake and value as an end.

The biocentric perspective has a mandate to preserve natural areas for their own sakes. Our duty is to protect these areas and to leave them to future generations as unspoiled as possible. Policy accords with this perspective by preserving the wilderness areas for their own sake and for the benefit of future generations (Godfrey-Smith 1992).

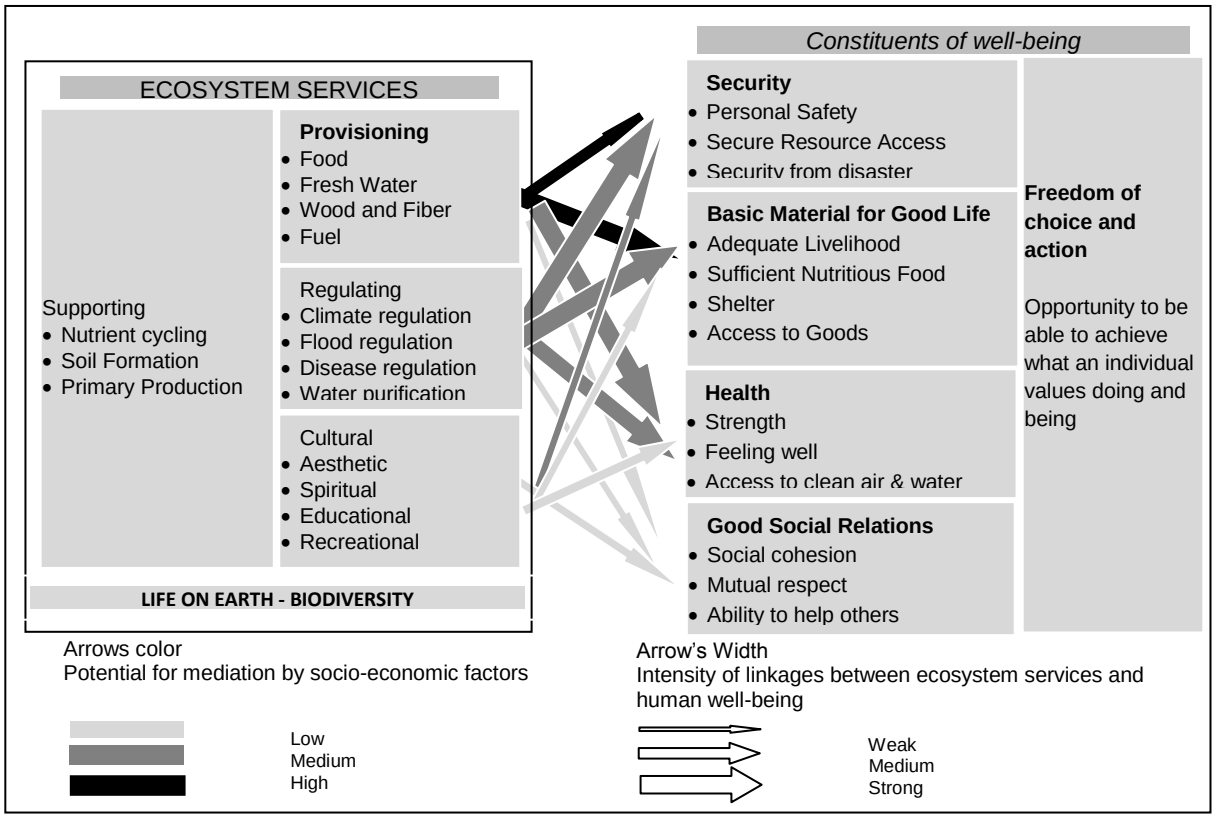
As a conclusion concerning both respectives, there is a need for legal instruments, namely as a political claim on ecosystem management and based on advancing scientific knowledge about ecology.

2.2. Functions of Forests

Forest ecosystems provide numerous benefits for humans namely social, economic and ecological. This large range of benefits has been recognized and considered by Central European forestry experts and scholars, specifically in Germany, since many decades (Riegert and Bader 2010) and has been integrated into forest management as ‘’multifunctional’’ or ‘’multi-purpose’’ forestry (Volk and Schirmer 2003; Bundesgewaldgesetz 1975). Currently, various benefits from forest ecosystems are discussed under the term ‘ecosystem services’[1]. A presentation of the relationship between ecosystem services and human well-being is provided in the Millennium Ecosystem Assessment Report (MEA 2003) as shown in Figure 2.1.

[1] The term Ecosystem Services directly relates to human well being; while the CBD Ecosystem Approach will attain the right balance between three factors: economic prosperity, social wellbeing and environmental sustainability. The outcome of balancing them in the right way can be measured in human well being (Maltby 2008).

Figure 2.1. Linkages between Ecosystem Services and Well-being



Source: MEA (2003)

Figure 2.1 depicts the strength of linkages between different categories of ecosystem services and components of human well-being that are commonly encountered and includes indications of the extent to which it is possible for socioeconomic factors to mediate the linkage. In addition to the influence of ecosystem services on human well-being depicted here, other factors like technological and cultural factors influence human well-being as well, and ecosystems are in turn affected by changes in human well-being. The figure also describes that socioeconomic benefits depend on ecological functioning ('supporting') although indirectly. However the supporting services of ecosystems will determine whether nature can be able or not to deliver the direct ecosystem services that humans may obtain.

Important forest functions or services supply can be described as follows:

2.2.1. Species Protection / Biotope or Habitat Function

To preserve this function, the management usually foresees 'Protected Areas', which are defined by the World Conservation Union (IUCN 1994) as an 'area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means'. By this definition, Protected Area is the essential component of in-situ conservation of forest biodiversity, which is defined as the total diversity of genes, species, ecosystems and

ecological processes in a region (SAF 1992, IPGRI 1993, Isik 1997 in Isik *et al.* 1997). Examples for this function are hotspots and ecoregions for guiding conservation planning and priority setting (Wikramanayake *et al.* 2002). Forest ecosystems provide specific habitats to flora and fauna depending on their integrity, vitality and capacity to cope with altering natural disturbances (Isik *et al.* 1997).

2.2.2. Process Function

The natural processes of forests include propagation, succession, competition, structural differentiation, aging, regeneration etc., which all need relatively long development periods. These natural processes are sometimes disturbed by detrimental factors. The complex forest systems create mosaics of different phases of development in space and time which perform partnerships and functional linking (cross-linking) (Körner in Scherer-Lorenzen *et al.* 2004).

2.2.3. Resources-Protection Function

With respect to resources protection, forests have to be seen as essential functional components of the entire landscape:

2.2.3.1. Soil Stabilisation Function

Soil conditions are one of the most important factors in the ecosystem. The soil is an important element for all organisms, a life medium and a source of nutrients. Soil erosion greatly affects ecosystem functions and integrity. Soil erosion is the process of detachment, transportation and sedimentation of soil particles. The natural erosion process is usually due to wind or water forces (Asdak 2002). Certain conditions and structures determine the high capacity of forests to stabilize soil in places and protect it against erosion forces.

Turbulent wind forces the soil to detach from the surface. Forests have the capacity to decrease wind velocity at ground level by acting as a wind-brake and dispersing the wind energy. The reduction of wind velocity depends on the trees' height, crown form, leaf density and position/location (Grey and Daneke 1986).

Water-forces also cause soil erosion in different ways, for instance splash-erosion, sheet-erosion, rill-erosion, gully-erosion, stream-bank-erosion etc. Splash erosion happens if the kinetic energy of water directly from raindrops or through leaves (tips drip) is high enough to detach soil particles from the soil surface. The level of kinetic energy/E_k depends on factors such as water-drop diameter, which affects the water-mass. It will be greater for leaves that have broader tips (E_k=1/2 mv^2). Factors, such as, slope, speed and wind direction, roughnes's of the soil surface and vegetation stratum also have some influence.

Hence, stratified forests therefore can reduce the rainfall's E_k before it reaches the surface floor. Sheet-erosion happens when a sheet of the soil surface is removed. It can happen when E_k from water-drops combines with runoff. In the initial phase, splash erosion reduces water infiltration capacity into deeper soil layers because soil pores are closed by the removed particles from the splash-erosion process. This type of erosion increases the potential runoff. Sheet-erosion potentially happens if the soil surface layer is fragile and the lower layer of soil is relatively solid. The speed of this erosion type is determined by the speed and the depth of water runoff (Asdak 2002).

The vegetation cover is the most important factor that decreases erosion risks which depend on climate condition, soil characteristics and topography. Wischmeier and Smith (1978) used these four factors as a basis for predicting soil erosion losses caused by rainfall known as Universal Soil Loss Equation (USLE). For soil conservation purposes, the forest or vegetation cover type should be able to protect the soil surface through reducing the terminal speed of the water-drops and decreasing the raindrop diameter. In this context, the existing lowest vegetation stratum is the most effective cover for protecting the soil surface to decrease runoff-speed and -volume and increasing the infiltration capacity of soils. It restrains soil particles in their place by providing an appropriate rooting system, leaving forest litters, craggy bark etc.; and finally to preserving the soil's capacity to absorb water (Asdak 2002).

2.2.3.2. Water Regulation Function

Forests affect the water regime of a region (watershed) with respect to quantity as well as to quality (Asdak 2002):

- The quantitative effect of forests is caused by increased infiltration. Forest's litter, bark etc. Form a humus layer and the quality of physical characteristic of the upper soil layer retards the water run-off. Due to the root system and high bio-activity in the soil which both cause high porosity and increase the storage capacity[2]. In this way they can function as a stream flow regulator[3].
- The qualitative effect of forests relies on the absence of pesticides, fertilizers, herbicides etc in forest management that otherwise are released into the water body. Additionally, forest humus, plants and trees can be highly efficient in mechanical and biological cleaning as well as through chemical exchange reaction with the forest's soil nutrients[4]. In this respect forests provide high purification capacities against different kinds of chemical inputs into the water body.

2.2.3.3. Climatic Protection Function

Climate is determined by air temperature, moisture content and wind factors. Forests can help to ameliorate local temperature by manipulating the albedo, that is, the proportion of the sun's radiation that is reflected. Increasing air moisture content from evapotranspiration reduces weather extremes (through energy/heat absorption by the moist-water particles). It

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[2] Evapotranspiration from forests is bigger than from other land uses, and the lower surface of forests is often drier during the dry-season. When rain comes, the water run-off will be limited because the water will be temporarily stored in the forest floor (litter, branches, etc.) and infiltrate below the surface through the soil pores (the number of pores is determined by soil type and organisms which live in the soil surface and the plant-roots). If the soil is saturated with water - depends largely on the local bio-geophysics (soil type, soil depth/geomorphology, etc.)-, evapotranspiration will only play in a limited role on reducing the total water run-off (see: flood). Forest vegetation greatly affects the balance of water through evaporation, interception and transpiration which depend on species and vegetation age. When forestation is used as an effort to protect water resources, it is important to consider the storage capacity of water in soil of the area, especially in dry areas with low precipitation (Asdak 2002).

[3] Most water-related problems for humans nowadays are mainly dominated by water flow associated to time of flow. The classic contrasting situation is between drought and flood. On watershed scale, the annual water volume flow will increase when forests are cut down (in large area), when deep-rooting species are replaced by shallow-rooting species, when vegetation cover which has high interception capacity is replaced by low interception. Based on these points, the increasing water flow is caused by the decreasing transpiration from vegetation, therefore the run-off water and water in soil will increase (Bosch and Hawlett 1982; Hibbert 1983; Hamilton and King 1984; Bruijnzeel 1990; Malmer 1992 in Asdak 2002).

[4] On a watershed scale, the result of this filtration function can be observed from the organic and inorganic particle content in the respective rivers' water. However, the river water will interact with riparian vegetation, and the amount of non-organic matter can increase due to abrasion from the riverbank.

also influences the local air circulation and produces better air quality. Forests do not only protect the direct airflow to the adjacent surfaces (wind breaking effect) but at the same time affect the air quality through air interchange with cooler and fresher air from the forests' interiors. The fresh air blows to adjacent land such as settled or agricultural land. In hot countries, the cooling effect of trees is likely to be more pertinent to urban dwellers. Studies have shown that the costs of air conditioning in buildings can be reduced by up to 50-60% depending on the location of the building and the trees around it (Miller 1988 in Carter 1994).

Beside their effects on local and regional climate, forests also have a role to moderate the greenhouse effect and thereby the global climate through photosynthesis processes. Carbon dioxide (CO_2) is one of the key greenhouse gases besides methane (NH_4) and nitrous oxide (NO_2), ozone (O_3) and fluorocarbon. The continuous release of greenhouse gases is raising the temperature of the earth, disrupting the climates, agricultural systems, raising sea level etc. Since the beginning of the Industrial Revolution, ever-greater quantities of oil, gasoline, and coal have been burned, forests have been cut and farming has been introduced instead (US-EPA 2000). Through photosynthetic processes[5], forests have a clear effect on the concentration of CO_2 in the atmosphere. Therefore, forests are also major allies in the battle against climate change and global warming[6] through removing carbon from the atmosphere (carbon-fixation) and sequester it in forests and forest products.

2.2.4. Object-Protection Function

The object-protection function of forests is to protect human life and well being (as well as infrastructure and buildings), from natural disasters, disturbances or negative anthropogenic impact[7], for instance:

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[5] In fact, 75% of all photosynthesis on earth takes place within phytoplankton in the ocean waters. Photosynthesis takes CO_2 out of the atmosphere, releases oxygen and stores carbon. One ha of green leaves can absorb about 8 kg CO_2. This is equivalent to the CO_2 that is released by 200 people as output from the respiration process (Grey and Daneke 1986). Photosynthesis is influenced by various factors. They can be grouped into two, namely internal and external factors. Internal factors cover age and leaf's structure, size and the stomata's response, number of chlorophylls, water turgidity and carbon accumulation, while external factors include light, temperature, CO_2 concentration in the air, water, soil fertility, pollutant concentration in the atmosphere and use of chemical substances, insects and diseases (Kramer and Kozlowski 1960).

[6] The *United Nations Framework Convention on Climate Change* (UNFCCC) has begun to consider ways to reduce global warming. In 1997, as an addition to the treaty, governments agreed to the *Kyoto Protocol*, which provides more powerful (and legally binding) measures. Since 1988, an *Intergovernmental Panel on Climate Change* has reviewed scientific research and provided governments with summaries and advice on climate problems.

[7] Forests can be damaged due to emission load like SOx. It is toxic for plants if the concentration in the atmosphere at the 0.1 –2.0 ppm level. The damage is shown in leaves with pale spots, brown color in the dead part, and clorosis (Ferry and Ward 1959).

2.2.4.1. Protection against Flooding

Flooding happens if water overflows the river capacity, flows over the riverbank and affects the surrounding areas. The determining factors of floods are vegetation cover, topography, soil type and moisture content, drainage-size and –density. These factors determine whether a watershed responds well or poorly buffered to precipitation (Asdak 2002).

Human activities like intensive land use by replacing vegetation that has high transpiration/interception by vegetation that has low transpiration/ interception will increase the water volume that reaches soil and speed-up the tempo to reach the water peak-discharge. Also activities that cause soil compaction such as intensive husbandry, road paving, construction of buildings etc. can significantly increase the water volume and water run-off, further increasing the peak-discharge. Activities that increase the infiltration rate will have the opposite effect; however, only initially[8]. If the rainy period is relatively long and intensive (high precipitation), the combination effects between soil and vegetation will decrease with respect to the absorption capacity. Therefore, forests act as buffers against floods but have limited effects in areas with high precipitation. A dominant factor that will significantly affect the ability of land to capture water volume is in fact not forest-cover as such but rather the depth of the forest soil (Asdak 2002).

2.2.4.2. Mitigation of Air Pollution

Air pollution is an environmental change towards an undesired condition, in which materials, energy, radiation called as pollutants enter the environment and affect the natural conditions of the air (Herman and Bisesi 2003). Basically, the natural composition of the air is relatively uniform around the world. The air we breathe and use for industrial processes is a standard mix of dry air components that is made up of approximately 78% nitrogen, 21% oxygen, and 1% argon (by volume) plus small amounts of carbon dioxide, neon, helium, krypton, hydrogen and xenon, plus water vapour (humidity) and varying small amounts of other components that reflect local conditions. The effect from industrialisation in urban areas is usually higher than in rural areas. Most pollutants come from factory chimneys or vehicles. Usually observations for air quality cover the amount of dust particles, heavy metal particles like Pb and pollutant gaseous like NO_2, SO_2, CO and HC in the air. All of them are dangerous for human health at certain levels.

[8] Research in British Columbia showed that peak-discharge suspend in a couple of hours after logging activity, due to rougher soil surface and greater number of surface detentions as well as higher numbers of branches and mulch over the surface which constrained the water run-off (Asdak 2002).

Forests can reduce the level of air pollution through:

- **Disposal of pollutant particles**

Particles will be trapped (disposed) by various parts of plants i.e. leaves, stumps, and branches. Leaves (lamina) are the most effective part of vegetation in filtering pollutant particles, but not all species have the same ability to filter and reduce the concentration of pollutant particles in the air. Leaves that are rough or have fine and tight hairy surfaces (pubescent) are more effective at trapping particles than leaves that have smooth and bold (glaborous) surfaces. Disposed on the latter, particles are easily washed out (dissolved) by the rain or carried away by the wind (Grey and Daneke 1986; Dahlan *et al.*, 1989). Forests do have the maximum filter capacity of all vegetation types, due to their high amounts of leave mass. Furthermore, forest soils play an important role in reducing atmospheric pollutants. They do not only trap disposed pollutants but neutralizes some of them through chemical reactions. In this respect, forests in and around urban settlements have greater potential for atmospheric cleansing than avenue and other spot plantings, where a layer of concrete and tarmac covers much of the soil (Carter 1994*).*

- **Diffusion of gaseous pollutants**

In general, gaseous pollutants will enter into plants through their stomata and they diffuse into the intracellular matrix and will be absorbed through the palisade's surface or parenchyma's cell wall (Treshow 1984);

- **Dilution**

Forests produce oxygen. Through the dilution process, gaseous pollutants mix with clean air (fresh air) reducing air pollution concentration (Grey and Daneke 1986).

Pollution sources are divided into three types: point source, if the source is not moveable e.g. a factory; area source, if the source covers a definite area which represents a number of small sources and is distributed over a larger area, e.g. a settlement area, industrial estate, etc.; and line source, if the source is like a strip and is determined to be continuously polluting, like roads, highways, etc. The type of pollution source is usually used as a considering factor for the effective measure of forests needed protecting the objects from emissions (Carpenter and Sani 1982).

2.2.4.3. Noise Reduction

The decibel scale (dBA) is customarily used to measure the approximate human perception of noise, from low frequencies to an annoying level. Usually several standards are used in the assessment of noise impact (example: noise levels in excess of 70 dBA are

perceived as annoying). For public places, these standards are instruments to protect the noise-sensitive receptors such as residential areas, hospitals, schools, offices, developed campgrounds, etc., where excessive noise may cause annoyance (health) or loss of work efficiency.

According to Farnham and Beimborn (2003 in Carreiro *et al.* 2007), trees cannot solve the problem of noise, but they help to reduce it to possibly acceptable levels, especially if combined with other measures aimed at controlling noise emissions. Forests have the function of decreasing noise impact, for instance from motor vehicle traffic, factories etc. Trees reduce noise pollution through various mechanisms:

- noise absorption: trees entrap or absorb sound vibrations. Best species for this is trees with many branches and thick, fleshy leaves with thin petioles (leaf stem). In fact, a sound attenuation barrier is most effective when located closest to the source of the sound. Large shrubby trees can be effective at scattering sound waves.
- noise deflection and reflection: trees bounce away and the noise back toward the source. The effectiveness depends on the density and rigidity of the barrier.
- noise refraction: trees effect through dissipation, diffusion or dispersion by striking a rough surface on any plain. The characteristic of trees is potential to bounce around and to vanish the noise.
- Noise masking: a different solution that does not like those three, 'noise masking' involves the substitution of tree against undesirable by desirable sounds, for instance a fountain that makes loud splashes.

Vegetation generates sounds, such as, the rustling of leaves in the breeze, and humans tend to selectively filter out undesirable city noise in preference for more natural sounds (Robinette 1972 in Carter 1994). The effectiveness of the last three mechanisms depends on the configuration in which trees are planted. In addition, the effectiveness of forests against noise will depend on the area's shape and on the season and weather.

2.2.4.4. Mitigation of Heat Radiation

In hot countries where the temperature is relatively high throughout the year especially in direct sun, shade from trees can comfort the citizens through reflection. Trees also provide protection from heavy rain and are commonly used for shelter, both at night for sleep and during the day by poor urban people. If carefully planned, trees may also be used to improve human comfort in urban areas by directing air movements. A line of trees, for example, may serve to obstruct, guide or deflect a current of air, while a tree canopy of only medium or light density can serve to filter the current in its passage (Miller 1997).

2.2.4.5. Protection against Falling Rocks

The surface will be mechanically stabilized by a good rooting system of vegetation. Deep rooting systems will be more effective at strengthening the bank i.e. protecting settlements or roads in the mountainside (Pupescu and Untaru 1998).

2.2.4.6. Curtaining of Undesirable Views

Forests can also serve to cover areas, such as, a single building, industrial areas, roads, dumping areas, etc., which disturb scenic beauty. This function's type is an aesthetic aspect rather than an ecological one, but it has the potential to comfort humankind in terms of psychological aspects.

2.3. Forests and Ecosystem Management

Designation functions based on classification of forest is necessary as a basis for forest management. However, constrains in implementation may appear primarily due to inconsistency on directions like commitment and regulations.

At a global level, various documents have been initiated addressing environmental and developmental issues[9] to promote ecological consciousness, particularly through the numerous processes after Rio. Several procedures to promote the sustainable use of biological resources have been initiated such as Ecosystem Approach (EsA), Ecosystem Management (EM), Sustainable Forest Management (SFM) or Multi-purpose Forestry. Their common aim is to provide guidance and to increase the applicability from the local to the regional and national level. Although consensus and commitments to these procedures have been adopted by many nations, various political barriers and implementation constraints are still to be met, due to the differing complexities of (inter-) human and natural systems and the incapability of the nations in developing an appropriate system to guarantee control.

2.3.1. Limitations of SFM

Selecting a suitable approach is necessary to advocate a certain goal, either as an explanatory sample or to prove the applicability of the chosen concept. It is specifically important since the Rio documents were principally adopted by most nations and the respective governments must update their legislation, also with respect to forestry (Wit 2003).

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[9] Prior 1992, IUCN-UNEP-WWF have issued books: Caring for the Earth, a Strategy for Sustainable Living (1991); 1992, Earth Summit: Rio Declaration on Environment and Development, Agenda 21, Statement of Forest Principles, The United Nations Framework Convention on Climate Change (UN-FCCC), The Convention on Biological Diversity (CBD).

When dealing with forests, SFM[10] has usually been considered, at first, since the forestry sector originally invented the concept, although with a far narrower approach than today. SFM is currently used to describe a forest management that not only looks for economic optimisation but also sets social and environmental goals. However, SFM is narrowly focused on forests, as defined by the stewardship and on the use of forests and forest lands (Ministerial Conference on the Protection of Forests in Europe 2002 in Sayer and Maginnis 2005). It does not include the interrelationships with other habitat types or areas outside forests nor does it provide goals and solutions for deforested lands, where the benefits of trees and forests are lacking. Thus, SFM is a limited concept to solve environmental problems particularly in urbanized landscapes where to initiate forest enhancement for the sake of 'non-forest' land would be needed.

The integration of forestry in 'non-forest' areas might be even more difficult, when the existing formal system of the respective country does not consider the whole range of forest functions.

FAO (as mentioned in Carter 1994) asserted that the history of canonicalization has a strong relationship with the current development in many countries, including the formal control system that still does rely on the colonial norms and legislation. This is mostly the case when the existing legislation of management and control is inherited from the colonial-period, which was enacted for the purpose of extraction and exploitation. As a result, the current understanding of sustainability in the scope of legislation as control system still gives more weight to production like timber harvesting and is considerably weak on social and moreover on ecological aspects.

2.3.2. Complements of EsA

A comparative analysis between SFM and EsA was carried out by the Laboratory of Ecosystem Management Swiss Federal Institute of Technology, leading to the following results:

(1) both concepts have similarities in regard to the concept of sustainability. They overlap significantly, and provide opportunities for mutual learning (CBD 2003b);

(2) both follow the same goal (FAO 2003), i.e. the management, conservation and sustainable use of renewable natural resources;

(3) SFM principles are basically complementary to what EsA means, however some differences are found concerning content or scope: EsA principles do not contain specific targets/objectives, but they can be a starting point for action, while SFM

[10] SFM can be traced to the so-called Forest Principles and Agenda 21-Chapter 11.

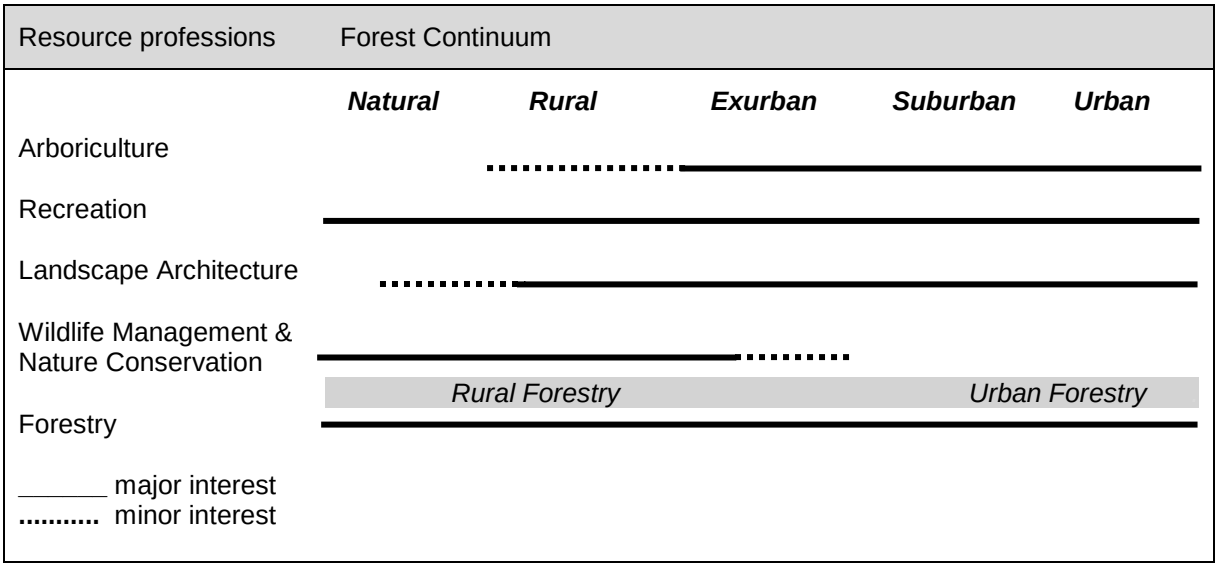
contains a specific target which is ‘timber oriented’. It follows an ‘outcome-based-approach’‘ but is not limited to it (this is shown by the use criteria and indicators) (CBD 2003b);

(4) SFM concerns only forest ecosystems.

EsA places greater emphasis on conservation issues, therefore, biodiversity can be better considered within cross-sectoral integration and inter-sectoral collaboration (CBD 2003a; CBD 2003b). In a broader context, EsA aims at greater integration than SFM. It encompasses broader societal concerns in all natural systems both, for natural areas and heavily man-modified systems. The intrinsic value of forests, even outside ‘forest land’ can be better promoted – which is called a holistic approach (Ellenberg 2003).

Nature protection should cover a wide spectrum of ecosystems from remote areas (where natural or semi-natural habitats usually dominate) to the cores of urban areas where the forest cover is small. As a consequence, foresters should consider the contribution and effects – actual or potential – of their activities over the entire landscape.

Figure 2.2. Area Responsibility from Resource Professions in the Forest Continuum



Source: Miller 1997 (p.35)

The forester's field of responsibility is traditionally limited to remote or rural areas where forests still cover greater proportions of the land. In urban areas, usually arboriculture looks after the trees while in wilderness areas nature conservationist protect natural forests against any kind of human impact (see Figure 2.2). With respect to urbanized environments, Miller (1997) asserted that both experts should cooperate and complement one another, since foresters are concerned with the ecosystem context rather than with single trees like arboriculturists do. Thus, the forester's role really is to promote forest functions throughout the entire landscape and the forester's profession is to assure the forest ecosystems integrity.

SFM criteria and indicators are well developed and widely adopted (IUCN, PROFOR, World Bank 2004; Schlaepfer *et al.* 2004). However they work only in forest areas or where forest areas are designated. Fragmented forest areas, where ecological integrity and functioning have been spoiled and degraded do not suit their application. From this point of view, SFM is not adequate to set development goals outside forestland and on the landscape scale. It neglects both, cross-sectoral integration and concerns at the landscape level (CBD 2004b).

In contrast to this, the UN-CBD EsA is designed to achieve further objectives that surpass sustainable use, like fair and equitable sharing of the benefits arising out of the utilization of genetic resources and nature conservation. A given set of general principles (''Malawi Principles'') fills in the SFM deficiencies mentioned above (Table 2.1). These principles provide a framework for action which has to be translated and transferred into management practices. The approach offers a more holistic view, which is applicable to all types of ecosystems (CBD 2004b).

Insofar, the concept was then considered to be still immature with much room for innovation. Some lessons learned for further EsA development are presented by Smith and Maltby (2003), study cases by Wit (2003), or application of the full set of EsA principles by Shepherd (2003).

In the CBD's 12th meeting of the Subsidiary Body on Scientific, Technical and Technological Advice on July 2007 in Paris, Settle (2007) presented his review to application of EsA. He summarized that EsA is ''a clearly and concisely articulated and a sufficient normative framework with global mandate for the management''.

Consequently, transforming the general EsA principles into concrete, specific and pragmatic outcomes of each respective sector were suggested. In the forestry sector, SFM was suggested to be the basis of CBD EsA. But country-led and eco-regional initiatives should be evolved to translate the concept into practice. Moreover, based on learning from experiences, Shepherd (2008) asserted that the EsA can only be implemented if public participation and sharing the knowledge of local people do exist. Based on the gathered knowledge, management goals and joint practical actions could be taken.

Shepherd (2008) also asserted that the twelve EsA principles (see Table 2.1) were successfully applied in his study areas with differing degrees of difficulty or success at each site. The twelve principles were grouped into five steps, namely: 1) key stakeholders, 2) area, ecosystem structure, 3) function and management, 4) economic issues, 5) adaptive management over space and adaptive management over time. Further results of the study were that the EsA is useful for planning, monitoring and evaluation of what went right and wrong. It provides a way of markings progress and noting incremental changes towards management goals. To summarize, EsA is an excellent assessment framework.

Table 2.1. UN-CBD Ecosystem Approach Principles and the Operational Guidance

The UN-EsA comprises 12 over-arching principles, which are complementary and interlinked, and 5 points of operational guidance for application of the EsA. The principles are adopted by CBD in 2000 from 'Malawi principles' that were developed in 1995. The Principles are:

(1) The objectives of management of land, water and living resources are a matter of societal choices.

(2) Management should be decentralized to the lowest appropriate level.

(3) Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

(4) Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:

   a. Reduce those market distortions that adversely affect biological diversity;

   b. Align incentives to promote biodiversity conservation and sustainable use;

   c. Internalize costs and benefits in the given ecosystem to the extent feasible.

(5) Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

(6) Ecosystems must be managed within the limits of their functioning.

(7) The EsA should be undertaken at the appropriate spatial and temporal scales.

(8) Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.

(9) Management must recognize that change is inevitable.

(10) The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

(11) The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.

(12) The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

The Operational guidance are:

(1) Focus on the relationships and processes within ecosystems.
(2) Enhance benefit-sharing.
(3) Use adaptive management practices.
(4) Carry out management actions at the scale appropriate for the issue being addressed, with decentralization to lowest level, as appropriate.
(5) Ensure inter-sectoral cooperation.

Source: CBD 2000

2.4. The EsA Principles and their Theoretical Support

Inspired by this, the author divided the EsA principles into three fields of activity for better practicability, namely: 1) management and organization issues; 2) spatial differentiation according to landscape, conservation and integrity issues; and 3) stakeholder and economic issues. Furthermore, the appropriate EsA principles at each field were

allocated. The particular reference is the CBD Guideline for ecosystem approach implementation as well as the annotations to the rationale (CBD 2004c).

2.4.1. Adaptive Management and Organization Issues

Allocated EsA principles: 1, 2, 3, 7, 8 and 9

Concerning forest management, a broader view of social and environmental issues is urgent. If a certain patch of forest is claimed to be of global value, this explicit global demand claims longer temporal scales and broader spatial scales to be addressed in forest management. If then the management concept has to be revised and adapted to such globally preferable demand that follows a certain ratified convention, the respective institutions and particularly governments will be faced with various consequences. However, the degree of revision depends on the capacity and capability of the responsible ministries.

Management is the key function of any organisation, from setting a goal to coping with risks. Concerning the management of natural resources like forests, external factors, namely the political situation, the market-economy or social pressures do play a considerable role, often even the greatest one. Generally, all related management units should be flexible and prepared to cope with this.

The following passages will discuss the management framework for organization and adaption in order to show how management can be prepared to react flexible:

2.4.1.1. Organization

According to Bolman and Deal (1997), organizational analysis mainly relies on four aspects, namely a structural perspective (’machine’), a human resources perspective (‘team’), a political perspective (‘strategy and tactic’), and a cultural perspective (‘symbolic’). Although all these aspects are important with regard to the efficiency and effectiveness of the organization; this discussion will just focus on the structural frame, because it directs our attention towards the effects of the existence or the absence of common goals or purposes of specific structures as well as rules and procedures. The direction toward such matters is the allocation of tasks to particular positions, the allocation of authority and responsibility, communication channels, establishment of rules and procedures to govern how to act in specified situations and procedures for coordination and integration.

The structural perspective is implemented to cope with any initiation of organisational change by developing and communicating a clear image of the future state to provide direction and reduce ambiguity. This might be by developing a design as complete as possible, communicated clearly through multiple channels (horizontal and vertical), including the future vision and a description of how things will operate (Nadler and Tushman 1988 in

Dunford 1992). Thus, the structural frame can also be used to analyse the absence of an overall design. It is essentially a device for transforming inputs into outputs where the design features, structures and procedures take centre stage.

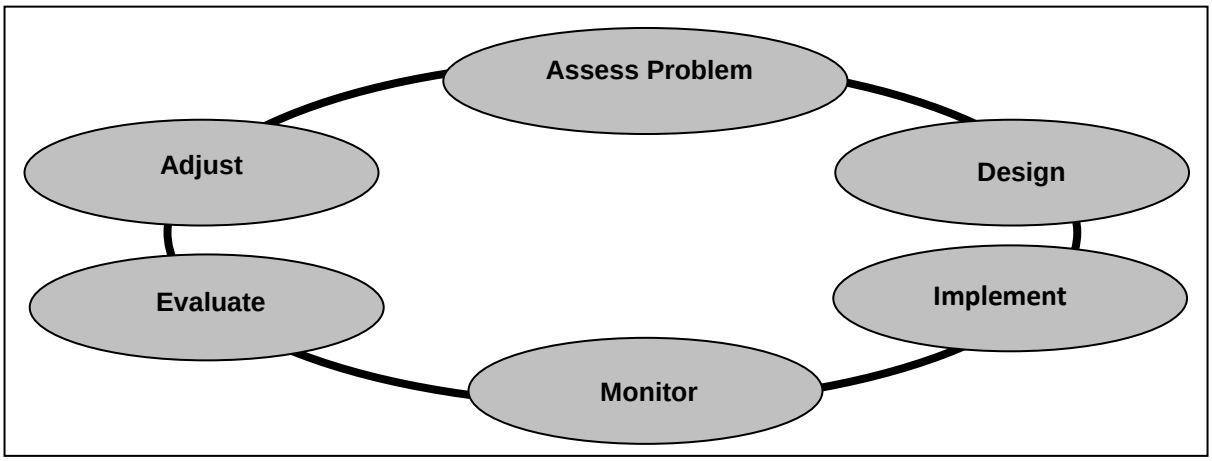
2.4.1.2. Adaptive Management

The term adaptive management has been used primarily in academic circles since the 1970s, but until recently, it has had little relevance for conservation practitioners. An adaptive management concept for ecosystems and natural resources is required since policy makers and resource managers have become dissatisfied with the traditional procedures and principles of resource management and sought for some realistic alternatives. The approach was first termed 'adaptive environmental assessment and management' and was shortened to adaptive management later.

There are various definitions to express what is ''adaptive management''. Adaptive management incorporates research into conservation action. Specifically, it is the integration of design, management, and monitoring to systematically test assumptions in order to adapt and to learn (Salafsky *et al.* 2001). Following FAO (2000), it is ''...a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs....''[11]; and according to United State Department of Agriculture/USDA (1993 in FAO 2000), adaptive management employs management programs that are designed to experimentally compare selected policies or practices, by evaluating alternative hypotheses about the system being managed. Based on this understanding, CBD (2004b) recommends a cycle of adaptive management with a number of essential steps:

[11] The British Columbia Forest Service (Ministry of Forests) uses this definition as the 'working definition' that emphasizes a thoughtful and organized approach. This approach, as asserted, has promise for application to various issues and scales, from testing alternative silviculture practices in forest stands, to ecosystem-based management for whole watersheds or landscape units, to evaluation of the effectiveness of Land and Resource Management Plans over sub-regional areas of several hundred thousand hectares.

Figure 2.3. Adaptive Management Process



Source: FAO's Recommendation on CBD V/6 (CBD 2004b)

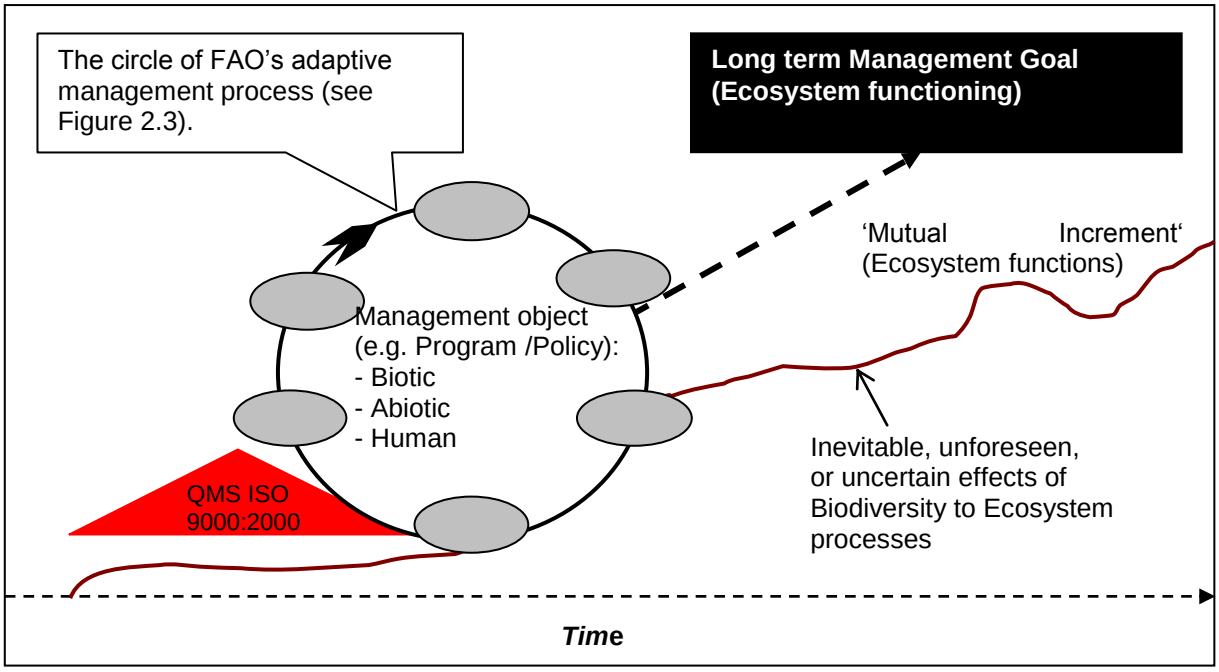
This FAO document identified some of the differentiating characteristics of adaptive management in comparison with common management, namely: 1) acknowledgement of uncertainty about what policy or practice is 'best' for the particular management issue; 2) thoughtful selection of the policies or practices to be applied (the assessment and design stages of the cycle); 3) careful implementation of a plan of action designed to reveal the critical knowledge that is currently lacking; 4) monitoring of key response indicators; 5) analysis of the management outcomes in consideration of the original objectives; 6) incorporation of the results into future decisions.

Adaptive management within the EsA framework requires a continuous ongoing improvement. The FAO's management cycle does clearly appoint steps of the management process, but does not express any kind of assurance. It just expects that the management follows the conducting policies, regulations, and/or declared societal goals as well as the approved operational standards comprehensively and adequately, although the uncertainty in conducting natural resource management is great (there is a clear need for indicators and assurance in the management process).

To assure a mutual increment, in which achievement can be objectively measured, a quality management system/QMS like ISO (International Organization for Standardization) 9000:2000[12] can be complimented, because it is a standard for all types of organisation either in production or service, including in natural resource management like forestry.

Inspired by those aspects, Figure 2.4 presents a combination between the standard for Quality Management System/QMS, i.e. ISO 9000:2000 which helps to assure each achievement of the organization, and the FAO's six steps management circle for adaptive management.

Figure 2.4. Adaptive Management Process in QMS



Own presentation, inspired from Quality Management System/QMS ISO 9000:2000

Principle 1- Laws and regulations as societal choices:

Different sectors of society view ecosystems in terms of their own economic, cultural and societal needs. Concerning forest management, one goal of forest arrangement is ecosystem functioning and integrity. However, this should not neglect local communities living on the land as important stakeholders. Their rights and interests should be recognized. Therefore, both cultural and biological diversity are central components of the ecosystem approach, and management should take this into account. In the management process, this

[12] The ISO 9000 for international quality management standards and guidelines has global reputation as the basis for establishing quality management systems. In this management system, a 'record/documentation' system is the basis. Various benefits can be obtained including a transparent goal that can be readily understood by all management unit levels as well as by other involved sectors or groups of people, avoiding duplication or overlap of activities (it helps to avoid potential conflict, counterproductive works or ineffective expenses from limited budget; a review can be done objectively to prevent inefficient work or to correct the inadequate goals/procedures/guidance. The management system can optimize the objectivity and therefore a subject for better policies upon ecosystems (ISO 2004).

goal should also be clearly targeted and communicated within the organization, with other conducting sectors and with the general public. At the same time adjustment may be necessary based on experiences from previous management practices or current scientific progress. Hence, management system standards like ISO 9000, its procedure, standards/norms and records are considered as centre tools that have to provide evidences for management effectiveness as well as for corrective actions. In a public sector like forestry, norms, standards and procedures are usually derived from the given laws and regulations.

These laws and regulations can be seen as 'societal choices' since they are products of people representatives. Laws and regulations should be used as tools to manage ecosystems in a fair and equitable way and prohibit impairing nature for future generations needs.

Principle 2 - Structural organization to the lowest appropriate level:

Concerning the structural perspective of management, the established system should ensure 'communication' from the top management to the lowest level. In the context of decentralization where responsibility can be endorsed on the lower level through various ways, e.g. delegation, deconcentration etc. Communication is dedicated to control and locally improve the expected conditions for instance the forest functions and their side-effects on the long run. Decentralized systems may lead to greater efficiency, effectiveness and equity. Management should involve all stakeholders and balance local interests with the wider public interests. The closer the management is to the ecosystem, the greater the responsibility, ownership, accountability, participation, and use of local knowledge.

The multiple stakeholders and their interests should be identified, and decisions about particular aspects of management should be assigned to the body that represents the most appropriate community of interest. If necessary, management functions/decisions should be subdivided. For example, strategic decisions might be taken by the central government, operational decisions by a local government or local management agency, and decisions about allocation of benefits between members of a community by the community itself.

In choosing the appropriate level of decentralization, the following factors are relevant and should be taken into account in choosing the appropriate body: whether the body represents the appropriate community of interest; whether the body has a commitment to the intent of the function; whether the body has the necessary capacity for management; efficiency (by moving the function to a higher level this might be better achieved maintenance at the necessary level of expertise to do the function efficiently and effectively); whether the body has other functions which represent a conflict of interest; the effect on marginalized members of society (e.g. women, marginalized tribal groups).

In some cases problems could be solved, such as through capacity-building. If no appropriate body is available at the level, a new body might be created, or an existing body modified, or a different level chosen.

Basically, decisions should be made by those who represent the appropriate communities of interest, while management should be undertaken by those with the capacity to implement the decisions. Decisions made by local resource managers are often affected by, or even subordinate to, environmental, social, economic and political processes that lie outside their sphere of influence, at higher levels of organization. Therefore there is a need for mechanisms to coordinate decisions and management actions at a number of different organizational levels.

The potential adverse effects of fragmented decision-making and management responsibilities should be compensated by: 1) ensuring that decisions are appropriately nested and linked; 2) sharing information and expertise; 3) ensuring good communication between the different management bodies; 4) presenting the overall combination of decisions/management to the community in an understandable and consolidated form so they can effectively interact with the overall system; 5) supporting relationships between the levels.

Institutional arrangements are the key for success. If you don't have the institutional structure that supports and coordinates the decision-making authorities their work will be worthless.

Principle 3 - Environmental Impact Assessment:

The anthropocentric perspective concerning ecosystem management proves that social systems can control ecosystems through management interventions. However, such management interventions may have unknown or unpredictable effects on other ecosystems; therefore, possible impacts need careful consideration and analysis. This may require new arrangements or ways of organization for institutions involved in decision-making to make, appropriate compromises if necessary.

Ecosystems are not closed systems, but rather open and often connected to other ecosystems. This open structure and connectedness of ecosystems ensures that effects on ecosystem functioning do not depend only on one system. Efforts like preservation and restoration should always consider the adjacent ecosystems, since changing environmental biological elements might affect them as well. The effects of management interventions, or decisions not to intervene, are therefore not confined solely to the point of impact. The effects between ecosystems are frequently non-linear and will likely have associated time-lags. There is a need to reflect the fact that impacts are directed in multiple ways – into and

out of a particular ecosystem, and not just adjacent and downstream. They may rely on connections like systems linked by migratory species. Management systems need to be designed to cope with such issues.

Natural resource managers, decision makers and politicians should consider the possible effects that their actions could have on adjacent and downstream ecosystems (river basins and coastal zones) and determine effects inside and outside the ecosystem. Where impacts of management or use of one ecosystem have or are projected to have effects elsewhere, the relevant stakeholders and technical expertises should be brought together to consider how best to minimize adverse consequences. Environmental Impact Assessment (EIA), including Strategic Environmental Assessments (SEA) should be carried out for developments that may have substantial environmental impacts taking into account all the components of biological diversity. These assessments should adequately consider the potential offsite impacts. The results of such assessments, which can also include social impact assessment, should subsequently be acted upon. When identifying existing and potential risks or threats to ecosystems, different scales need to be considered. Feed-back mechanisms to monitor the effects of management practices across ecosystems need to be established and or maintained. Evaluation and adjusted action are the appropriate ways of the responsible administrating organization on the national or regional level.

Principle 7- Spatial and temporal scale:

In the local context, forestry facts challenges like preserve native trees, maintain and improve local ecological knowledge, and protect the given nature as local identity as well as to promote them to the community. In the regional context, collaborative planning between different sectors or cooperation with the adjacent regions can be attempted. It should follow overlapping biophysical characteristics like between upper land and lower land in a basin, trans-regional wilderness habitats and corridors. Climate change can only be tackled together because the success depends on supra-regional planning and local action. Concerning conservation issues, a natural habitat is usually not defined by administrative borders. Wildlife species do need a wide range that can cover district, basin, province, and island or even over border of a country. Likewise with conservation issue, it is an issue in all sectors that might be relevant to cause habitat quality.

Forest functions arrangement should be dedicated to recognizing the multiple functions of forests shaped by the natural conditions and land use structure. Its management priority is to maintain the ecosystem's integrity, functionality and resilience. The following are relevant factors to cause habitat quality:

Forest function designation is basically determining the type of functions and the treatments and maintenance of forest areas. Therefore boundaries for different management

goals are defined, but connectivity between areas should be promoted where necessary. Connectivity is important to maintain interaction and integration of genes, species and ecosystems. Since forest ecosystems do vary considerably in structure and composition through time, management has to consider more than one scale to meet management objectives. Forest ecosystems are also influenced as well by the dynamics of human social and economic systems that vary across scales of space, time and quality. The verification of presence concerning ecosystem components depends partly on the scale of observation: at one scale, individuals of a species may seem relatively regularly and continuously distributed but at another the distribution may be discontinuous.

Likewise with time: At one time scale (e.g., monthly, annually) a component or process may appear in a predictable way; at another, longer or shorter time scale, the temporal dynamics may be unpredictable. Thus, management processes and institutions should be designed to match these different scales of the aspects of the ecosystem to be managed, given that ecosystem components and processes are linked across scales of both space and time, management interventions need to be planned to transcend these scales. Failures can result in mismatches between the spatial and the time frames of the management and those of the ecosystem being managed. For example, policy makers and planners sometimes may have to consider shorter time frames than the time frames of major ecosystem processes. The reverse can also be true, for example, where bureaucratic inertia can delay the needed quick management response to address rapidly changing environmental conditions. Spatial mismatches are also common, such as when administrative boundaries and those of ecosystem properties or related human activities that they are designed to regulate do not coincide.

Enhanced capacity is required to analyse and understand the temporal and spatial scales at which ecosystem processes operate, and the effect of management actions on these processes and the delivery of ecosystem goods and services. Identification of spatial patterns and gaps in connectivity should be included in this analysis. Functional mismatches in the administration and management of natural resources should be avoided by readjusting the scale of the institutional response to coincide more closely with spatial and temporal scales of processes in the area under management. This logic underpins the current global trend towards decentralized natural resource management. Given that ecosystem components and processes are linked across scales of both time and space (Turner *et al.* 2001), management interventions need to be planned to transcend these scales. Under normal circumstances and planning horizons, succession occurs up to the point where a self-maintaining community of organisms reaches a steady state within a specific site. When succession is disturbed, the community will respond in a variety of ways. The reactions of forest communities to alterations are various. The sequence of change in forest development

can be assessed from the impact of the applied management regime at each period of time. Developing a nested hierarchy of spatial scales may be appropriate in some circumstances. Managing large areas such as river basins may require development of new institutional mechanisms to engage stakeholders across administrative borders and different levels of administration. Indeed, regional collaboration is necessary to deal with large-scale changes. In this respect, (forest) ecosystem functioning should be placed as a 'long term' goal. Attention to spatial and temporal scales is needed in the design of assessment and monitoring efforts.

Principle 8 - Long term management goals:

If ecosystem functioning (and integrity) is the main goal of ecological forest management, the respective management system should cover a long-term vision explicitly converted into plans where ecological processes are accommodated.

Ecosystem processes are characterized by varying temporal scales and lag effects. This inherently conflicts with the tendency of humans to favour short-term gains and immediate benefits over future ones. Therefore, trade-offs between short-term benefits and long-term goals in decision-making processes should be taken into account.

Time needs to be considered explicitly in formulating management plans. Long term processes need to be considered and planned for because these are otherwise often neglected. The lowest level in management systems are records (data). Records in forest management are necessary to observe the lag of adaption over time and find out the trend. Periodical forest data and information, like inventory's data, are necessary to perform the state and trend of the forest conditions relating to the conducted management treatments. Usually, they are very important as a basis to develop appropriate decisions at time. For forest management, to achieve ecological functioning should be essential and needs to identify the necessary efforts to support this long run goal. However, some challenges are usually faced in forest management like: 1) difficulty to detect long term trends than short term trends particularly in complex systems; 2) Management systems tend to operate at relatively short time scales, often much shorter than the timescales for change in ecosystem processes; 3) where there is a lag between management actions and their outcomes, it is difficult to take reasoned management decisions; 4) ecological functioning (and integrity) as a result from long term processes require extensive processes and awareness to detect them. Both need to determine and to characterize the ecosystem properties; 5) Thus, monitoring systems should be designed to accommodate the time scale for change in the ecosystem, and low frequency changes in ecosystem structure and functioning should be strengthened; 6) Stability of institutions, legal and policy frameworks, monitoring programs,

and extension and awareness-raising programs are required to implement long term management**.**

Principle 9 - Adaptive management:

Ecosystems do change continuously, including species composition and population abundance. In general, the current scientific knowledge concerning our capacity to define how ecosystems are functioning and to determine their performance is still imperfect. Looking at the inherent dynamics of change, ecosystems represent still a complex of uncertainties and a source of 'surprises'. Hence, management should adapt to these changes. Traditional disturbance regimes may be important for ecosystem structure and functioning, and may need to be maintained or restored.

Adaptive management is applied in order to anticipate and cater ecosystem changes and events. It is also a basis to consider mitigating actions to cope long term changes like climate change. The adaptive management objective should be construed to maintain natural ecological processes rather than fixing certain states and outcomes.

New knowledge and understanding can be used to improve management approaches in responding the changing circumstances. Changing ecosystem states and functioning is usually caused by social and ecological changes. Involving observations and monitoring of the taken actions of ecosystem management will generate new knowledge in onward and reduce uncertainties. By involving a learning process, adapted methods and practices, will support the improvement of the quality of ecosystem management.

Adaptive management is expected to facilitate better and more immediate responds to risks of degradation or loss of habitats. Therefore, the identification of risks and uncertainties as well as monitoring systems like highly vulnerable areas, monitoring systems, socio-economic and ecological are important as an integral part of adaptive management.

2.4.2. Spatial Differentiation according to Landscape, Conservation and Integrity Issues

Allocated EsA Principles: 5, 6, and 10

'Area' can be defined as the specific space for a complex system of humans and their environment where various interactions between their sub-systems (like biological, use, production, economy, society and culture) are found. Therefore 'area' can be determined in various ways with respect to its management.

According to Forman and Godron (1986), landscape is a mosaic or a cluster of local ecosystems which are repeated in similar form over a kilometres-wide area. The sequence of local ecosystem shows regional differences due to local bio-geographical characteristics

which overlap juridical borders. The natural biophysical characteristics in a given area should be considered to determine comprehensive ecosystem characteristics. These should receive higher priority in the earlier endeavours than political purposes which are usually determined by juridical borders.

Landscape elements are small, relatively homogeneous units, or spatial features that can be found in a landscape mosaic. This refers to each patch, corridor, and area of matrix in the landscape.

Landscape structure refers to the spatial arrangement including forest patches, agricultural fields, grasslands and other elements, such as, infrastructure like roads and waterways (Dramstad *et al.* 1996). Forests in their differing structures and functions are one of the many ecosystem types that can be looked at to judge and determine the integrity of a landscape's ecological household. The forest growth and structure growth is determined by its surrounding factors i.e. soil, topography, water, climate, disturbances etc, which thus are to be considered as forest ecosystem characteristics in the above mentioned sense. Ecological functions at the landscape level refer to the interrelation between biota and structure (e.g. migration corridors, feeding grounds) and the movement of materials, water, wind and energy through the structure.

Various concepts or models address landscape ecology related forest structures and functions, such as, forest fragmentation, connectivity, patch-size, and protection of species at risk. Fragmentation, or the splitting and isolation of habitats that used to be connected can pose a major threat to the biodiversity hosted in forest ecosystems.

From the point of view of nature conservation, three types of areas with different relevance and function for nature conservation are known:

(a) Natural Areas

Large and intact forest patches, such as large primary forests roadless areas and protected forest reserves, may serve as refugee areas and maintain important habitats for numerous species, particularly forest interior species e.g. thrushes and wide-ranging carnivores.

Nature protection in these natural areas can be determined as all measures for the preservation and promotion of wild plants and wild animals, their partnerships or communities within their natural habitat in a certain landscape or part of a landscape under natural or near-nature conditions (Bohn *et al.* 1989). This determination tends to a biocentric adjustment for wild species and their habitats.

The conventional nature protection goals (for ecosystem management) tend to protect selected and usually endangered species and biotopes. Accordingly, the remaining parts of

natural or primary forests where specific species do still exist have first priority to be protected due to their sensitivity and their space requirement. Natural dynamics in all development phases (process protection) is a further important goal. This is one of the reasons why protected forest areas should be large, apart from the fact that forest animals might have rather extended home ranges.

To support the nature-protection goal for these large priority *areas* or shelters, nature conservation creates buffer zones around them where cautious land (forest) use can be allowed. It also provides retreat areas that serve as stepping stones or corridors between them. Smaller patches and corridors can maintain the connectivity of those areas and facilitate the spatial flow of animals and genetic material (Forman and Godron 1986). The following table describes some types of habitat corridors:

Table 2.2. Types of Habitat Corridors

Type of Corridor and Description	Functions and Benefits
Strips of native habitat, such as hedgerows and greenways, that link habitat patches	These corridors enable animals to move among habitat patches and are the essence of what many biologists mean when they use the term.
Elongated habitats that follow long, narrow landscape feature such as rivers, ridgelines or rights-of-ways.	These corridors do not necessarily connect larger habitat patches, though they may protect important habitat.
A series of stepping stones refuges for migrating birds	These may be a useful alternative to a true movement corridor for birds and other migratory animals
Tunnels under highways (or bridges over them) that allow animals to move across the landscape.	These linkages help prevent road kills and keep populations genetically connected.
Mega-corridors, which are essentially large, oblong nature reserves	Corridors that are wide enough to contain the average home range of large carnivores may help in large scale conservation efforts.

Source: Perlman and Milder 2005, p.148

Additionally, smaller natural forest areas should be reserved within managed/production forests, i.e. specific small habitats or other natural forest characteristics that can occur around springs, along rivers and creeks, on rock formations or under extreme site conditions. Depending on their size, location and exposure to human impact or pressure, these smaller natural areas might need specific safeguarding measures or restrictions for use.

(b) Semi Natural Areas

According to the Invasive Species Specialist Group IUCN (2000, p.6), a semi-natural ecosystem is ‘an ecosystem which has been altered by human actions, but which retains significant native elements’. Semi natural areas can be considered as a subset of land with valuable habitats or sites for species that –to a certain extend- tolerate or even follow human influence and disturbances caused by land use (for example secondary forests, edges of

forests or cropland, fruit gardens, hedges, fallow land etc). The biodiversity in these areas differs from that one of natural areas and it depends highly on the kind, frequency and intensity of human impact and its slow and careful development.

Semi natural areas are usually found in rural areas where they form an essential and integral part of the cultural landscape that fulfils a great range of the forest functions. UNESCO defines the term cultural landscape as the diversity of manifestations of the interaction between humankind and its natural environment. Cultural landscapes often reflect specific techniques of sustainable land-use, considering the characteristics and limits of the natural environment they are established as well as a specific spiritual relation to nature. Conservation of cultural landscapes can contribute to modern techniques of sustainable land-use and can maintain or enhance natural goods and services in the landscape. The continuous existence of traditional forms of land-use supports biological diversity in many regions of the world. The conservation of traditional cultural landscapes is therefore helpful in maintaining biological diversity.

Accordingly the Japan Agency for Cultural Affairs (2003 in JICA and DepKimpraswil 2004) defines cultural landscapes as landscapes of high value which exist against the background of nature, history and culture of agriculture, forestry or fishery communities, in close relation with traditional industries, and modes of life, and embraces a unique land use or natural feature representative for the respective area.

(c) Urban Areas (Green Space Areas)

The highest contribution of Carbon-dioxide (CO^2) emissions in 1999 in Indonesia was traced back to the transportation sector (24%), followed by public electricity and heat production (21%), manufacturing and construction (18%), residential (17%), other energy industries (16%) and others (4%). Most emission sources came from liquid fuels (PEMSEA 2003). In Indonesia, liquid fuel like benzene is still added with lead (Pb) to increase fuel's characteristic during the burning process especially for machines with high compression (Brodjonegoro and Soekanto 1992). In urban cities, high concentration like Pb emission impacts negatively on the environment and health. In this case, trees and forests can help as a mechanic-barrier to such particles. Their barrier of the effectiveness depends on tree species and their structure (after Suryawan 2001 in Makatita 2003).

Beside CO^2 and SO_x is the main gaseous pollutants produced by vehicles. These substances affect negatively humans and animal's health as well as can kill plant as well. Tree to a certain degree can reduce air pollution levels (gaseous or particles) as well as an indicator of air pollution through its specific effects caused by physiology disturbances, for instance change of leaf morphology, pigmentation etc. SO_x substance is of local importance due to its short time existence in the atmosphere (11 hours – 4 days) (Bowen 1966 in

Masrikan 1990). Some researchers found out that different tree species react variably to each type of pollutant. For instance *Angsana* (*Pterocarpus indicus*) and *Glodokan* (*Polyalthia longifolia*) which are usually planted on street-sides of Java, have higher capacity on absorbing SO_x than *Mahoni* (*Swietenia macrophyla*). The effectivity of pollutant absorption is influenced mainly by leaf morphology and by physiology characteristics. Typology of vehicles' fuel and road's system e.g. truck-solar-primer road system or car-benzene-secondary road system should be included on the consideration for effectiveness species selection in urban forests.

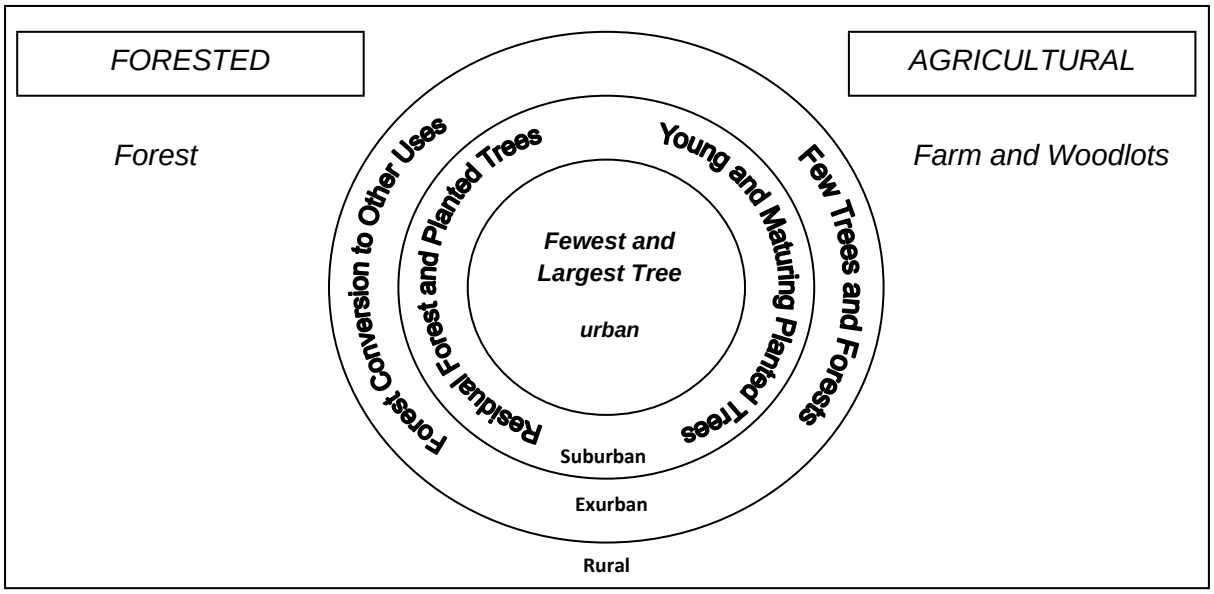
Beside pollutions, the increasing local climate in hot countries like Indonesia is likely being a problem as well. Uncomfortable climate is caused by land use change that increases the level of albedo, like into roads, buildings etc. Urban forest in different shape (compact, distributed or line form) affects the micro climate i.e. air temperature, moisture content, wind speed and albedo differently. A research that was conducted in urban forests of Yogyakarta concluded that a compact form is the most effective one, followed by tree in distribute form and then line-form. The decisive factors are: tree density, tree height, canopy height, total canopy-size and the surrounding physical conditions. The role of forests relating to local climate is very significant especially for hot areas like Indonesia (Fatimah 2003).

GSA's arrangement as the entire patchwork of natural features and sites in urban–suburban areas, including residential areas, can save as a measure for landscape conservation and nature protection in cities and villages. GSA pursues a landscaping goal within a settlement range. It emphasizes a certain spatial functional arrangement of all green areas and green elements connecting them to each other and to the structural facilities with respect to their ecological functions, aesthetics and recovery or re-creative effects. To safeguard human health and well-being through green space arrangement and functioning, i.e. air pollution control, noise protection, climatic optimization, radiation protection, water protection, soil protection etc., is a most important task for urban development. Management boundaries do usually determine the extent to which GSA's arrangements have their effect in a region in term of habitat function and biodiversity (Bürger-Arndt 2004).

Additionally, urban biodiversity has distinctive characteristics (Müller 2007). The variety of urban habitats are shown by the variety of designed purposed areas, for instance residential area, gardens, parks, industrial areas, railway area etc. Urban area serves as valuable habitats for (migration) birds; as centres of importation, naturalization and spread of exotic species; as centres of evolution and adaptation. Urban area has distinctive characteristics of biodiversity, for examples a variety of species only occur in cities, distinctive biodiversity, species diversity of urban habitats are different and urban biodiversity is endangered due to standardized landscaping against nature.

Miller (1994 in Miller 1997) describe the development of GSA from (the land use characteristic of) forested and agriculture regions, as shown in Figure 2.5.

Figure 2.5. Land Use and the Urban Forest in Forested- and Agricultural Region



Source: Miller 1994 in Miller 1997

In urban societies, there is no more clear separation between urban and rural forestry because urban values permeate the collective value system. Practically it will be largely determined through legislation (Rhodes 1971 in Miller 1997).

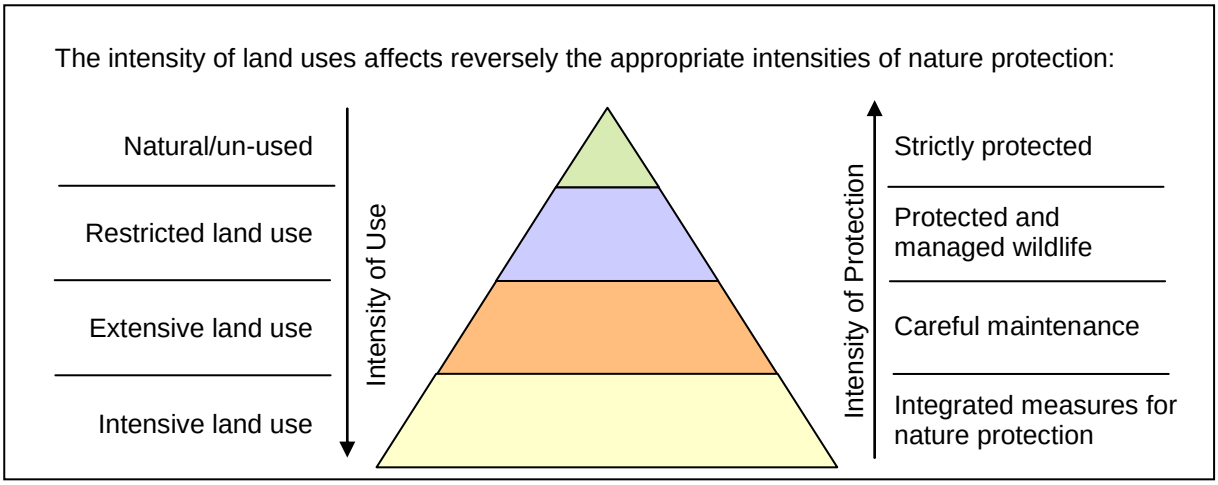
Another extremely important service of forests in highly populated urban landscapes is their ability to provide healthy environments, not only for wildlife but also for the citizens (Fitzpatrick and LaGory 2000). With regard to health issues, forest is one of the determining factors. Forests in urban areas are specific as well as their management.

The whole range of landscape situations, from natural/wilderness to semi-natural/rural and to urban area should be considered in forestry management and treatment with respect to the specific forest functions.

To summarize what has been explained with respect to forests and their arrangement at landscape level that considers their specific and rather different functions for environment purposes, biological diversity, nature conservation and human health must be understood within a continuum from natural to man-made ecosystems. This will give the flexibility to cope with situations rather than just dividing areas into protected or non-protected. Accordingly, since several decades German nature conservationists claim to respect nature conservation issues across the board, i.e. for the entire landscape, and develop specific and appropriate conservation or management strategies –from strictly protected and unmanaged to a

minimum of nature conservation measures that are integrated into intensive land use techniques (Haber 1971; Erz 1978; Bohn *et al.* 1989), also see Figure 2.6.

Figure 2.6. Nature Conservation Goals in Accordance with land Use Intensity



Source: Haber 1971

Principle 5 - Forest arrangement to maintain ecosystem services:

Ecosystem functioning and resilience depends on biotic conditions and their abiotic environment, as well as the physical and chemical interactions within the environment. Both spatial hierarchy and temporal pattern are very important components to be combined in forest management which can give information about the respective structure, function and integrity. They can be a reasonable basis for forest arrangement for conservation, protection, buffer-zone, riparian areas, habitat patch connectivity, green space areas in cities etc. Although their interactions are not always well understood, appropriate long term maintenance of biological diversity is more than simply protection of selected and endangered species, or dividing an area into 'protected' and 'non-protected'.

EsA aims at the benefits which result from such a holistic arrangement (in diverse ecosystems) including the cultural background. Where an area is being degraded and the expected functions are becoming in-appropriate, efforts like forests preservation, restoration (re-greening, reestablishment, afforestation or reforestation) need to be introduced to increase the ecosystems' resilience and maintain their functioning and services species.

Biodiversity conservation and the maintenance of human wellbeing depend on the functioning and resilience of natural ecosystems. They need: 1) Improved understanding of the interrelationship among ecosystem composition, structure and function with respect to (a) human interaction, needs and values (including cultural aspects), (b) conservation management of biodiversity, and (c) environmental quality, integrity and vitality. 2) Determination and definition of conservation, social and economic objectives and goals that can be used to guide policy, management and planning using participatory processes. 3)

Assessment of the extent to which ecosystem composition, structure can function contribute to deliver goods and services to meet the desired balance of conservation, social and economic outcomes.

Forest arrangement based function can be developed and promoted as management strategies and practices to ensure the maintenance of ecosystem services. Where required, management strategies and practices to facilitate the recovery of ecosystem structure and function (including threatened components) to generate or enhance ecosystem services and biodiversity benefits must be developed. Furthermore, instruments that contribute to the achievement of conservation management goals through a combination of managing protected area networks, ecological networks and areas outside are needed, while monitoring population sizes of vulnerable and important species should be linked to a management plan that identifies appropriate response measures and actions.

Principle 6 - Precautionary approach to maintain ecosystem functioning:

Considering the natural environmental conditions that tend to be degraded and limited in their productivity, structure, functioning and diversity, management should be cautious. As mentioned above, ecosystem management should maintain ecosystem integrity and capacity to continue providing the goods and services for human wellbeing and sustainability by focussing on factors that drive changes. This is because our current understanding is insufficient to define the ecosystem limits precisely, therefore a precautionary approach coupled with adaptive management, is advised.

Ecosystem functioning has a limit. There are limits concerning the amount of disturbances that ecosystem can tolerate, depending on the magnitude, intensity, frequency and kind of disturbances. These limits are not static but may vary across sites, through time, and in relation to past circumstances and events. Assessment management intervention over space and time is needed to consider the ecosystem limits, for instance considering substantial changes in composition, structure and functioning which may result from a loss of biodiversity and lead to lower productivity. It may be difficult to determine the actual limits due to a considerably lack of knowledge and uncertainty in ecosystems. Efforts like research to reduce the uncertainties about the given dynamic and complex nature of ecosystems may not give yet perfect understanding. Therefore, adaptive management focussing on active learning derived from monitoring outcomes of planned intervention are important to be accurately determined. Management to restore lost capacities or control use should be appropriately cautious.

Implementing an adaptive management is a precautionary manner which usually 1) considerates, develops and promotes appropriate management strategies and practices that sustain resources and maintain ecosystems within the limits of their functioning

capacities; 2) identify unsustainable practices and development appropriate mechanisms for improvement involving all stakeholders; 3) encourage environmental assessment and monitoring in order to provide management feedback and develop appropriate responses; 4) formulate, review and implement a regulatory framework, codes of practice and other instruments to avoid using ecosystems beyond their limits.

Principle 10 - Zonation and multi-functionality of forests:

Biological diversity is critical both for its intrinsic value and because of the key role it plays in providing the ecosystem and other services upon which we all ultimately depend. There has been a tendency in the past to manage components of biological diversity either as protected or non-protected. There is a need for a shift to more flexible situations, where conservation and use are seen in context and the full range of measures is applied in a continuum from strictly protected to human-made ecosystems. Biological resources play a role in providing the ecosystem goods and services on which humans ultimately depend. In this regard, like forests should be designed not only to support the conservation of biodiversity and the sustainable use of its components, but also the equitable sharing of benefits derived from the use of biodiversity. Those sustainable use and management depend also on the achieving conservation objectives. Indeed, management for conservation and sustainable use can be integrated. Integration can be achieved at various scales and in various ways including both spatial and temporal separation across the landscape as well as through integration within a site. Concerning on urban area, urban ecologists should explore the city as a natural environment (Beatley 1994). Even if the definition of ‘urban’ depends on the country’s context, the concept of wildlife exploration can also be applied to sub- or ex-urban or rural areas. Thus, the forestry plan should consider the entire area as a continuum. Consequently like participatory integrated planning should be promoted to ensure full range of possible values and use options can be considerate and evaluated, at the same time, innovation mechanisms and suitable instruments to achieve balance between particular problem and local circumstances should be developed.

2.4.3. Stakeholder and Economic Issues

Allocated EsA Principles: 1, 4, 10, 11, and 12

According to Batson 1972 (in Purser 1997), an organism plus its environment form “unit of survival” which involves more than just the physical environment, namely also the bological connex with all interrelations which are relevant for the respective organism. In this respective, the co-evolutionary perspective highlights that the environment has a broader meaning. With respect to the human environment it even includes the entire network of interactions between human consciousness, social systems and the natural environment. Lal

(1997) asserted that, although socio-economic and political forces drive physical processes, such as soil degradation, it only follows the natural water flow but neither social nor ethnic or political boundaries. However, success and failure of erosion control and other processes depend, to a large extent, on whether control measures are implemented. If the value of an ecosystem and its natural resources is included in the magnitude of economic value, land degradation like in Asia may be as high as three times the Gross National Product/GNP of the countries (Samra and Eswaran 1997 in Lal 1997). Nevertheless, Asian countries have paid much less attention to ecological conservation and sustainability than to pure biomass production so far.

According to Lal (1997), some global experiences in spatial forest planning include:

a) biotic and abiotic characteristics and cultural elements have formed landscapes;

b) the spatial arrangement of land use is dynamic and undergoes permanent changes, determined by social value systems that directly or indirectly influence forest land use as well as government policies;

c) legal systems contribute to the realization and performance of forest functions and have the potential to change forest conditions;

d) political and juridical boundaries are more decisive than natural boundaries. Political boundaries usually represent political, social and economic differences or issues rather than natural ones.

In densely populated areas, land scarcity, particularly for settlements, has become a major problem. The conflicts of land uses are greater because land has gained a high economic value. The expansion to remote areas where forests have still remained, results in degradation and fragmentation of natural habitats. Therefore conflicting interests from different sectors become a major challenge to manage forest arrangement for public welfare. However, ecosystem functioning needs spaces to develop and provide certain benefits. The challenge is not only how to identify ecological functions of forests, but also how to get them to work appropriately and reliably despite different ownerships.

Each locality has a unique bio-geophysical context. In a decentralisation process, local characteristics and in addition societal interests are expected to be much easier to identify. Thus, in the process of development, all stakeholders should be included to prevent lasting disputes and conflicts. A mechanism has to be developed to allow public involvement, participation, communication and exchange of information. It should also determine responsibilities, ownerships, and accountability. For this purpose, a sufficient knowledge about the locality and the region is required. For instance: in Environmental Impact

Assessment/EIA, it is required to give information to the citizens through Environmental Impact Statement/EIS.

To increase management efficiency and improve equity and justice for the local people, terms like participation, empowerment, bottom-up approach etc. have become increasingly common in the context of development advocation since the mid-eighties (Henkel and Stirrat 2001). According to the World Bank (1996), the term of participation can be categorized in two forms, namely popular participation and stakeholder participation. The first refers to the participation of the poor or disadvantaged in terms of gender, wealth, ethnicity or education; whereas the second refers to the participation of all relevant stakeholders in the respective development process, involving influential and powerful parties. Actually, the latter seems to have more implications in the developmental processes.

Participation in forest management refers to active involvement of various stakeholders under various aspects, for instance, defining forest management objectives, determining beneficiaries, managing forest resources, resolving conflicts concerning forest uses and monitoring and evaluating the performance of forest management practices. Forests provide diverse benefits to multiple groups of users. Therefore participatory forestry involves a broad view on forest resources that takes into account their multiple values, the social economic needs of forest users and the limited institutional and resources capacity of governments (Banerjee *et al.* 1997).

2.5. Inter-Sectoral Collaboration

If the urban population in Indonesia continues increasing in size and growth rates, this will undoubtedly stress the already impacted natural environments further. Vast natural forests have already been converted to other land uses. The EsA perspective offers the opportunity to address the practical problems related to anthropogenic impacts on the natural environment and also provide opportunities to examine the fundamental ecological questions concerning the structure, function and organisation of entire landscapes and their forests.

To understand how different processes that are embodied by the ecosystems do operate and relate to each other is a crucial step in gaining the capacity to manage ecosystems to sustain ecological services. Therefore ecosystem science contributes to ecosystem management since it leads to greater understanding of processes within ecosystems, including the effect of human activities.

It may depend on the context if the EsA principles can address the overall ecological networks. Besides considering lesson learned from SFM and placing greater emphasize on

better cross-sectoral integration and collaboration as well as on the interaction between forests and other habitat types within a landscape, case studies are requested[13] (CBD 2004).

Principle 1 - Societal choice as a result of democratization process:

Indigenous peoples and other local communities living on the land are important stakeholders and their rights and interests should be recognized. Both, cultural and biological diversity are central components of the ecosystem approach, and management should take this into account. Societal choices should be expressed as clearly as possible, for instance they are determined through negotiations and trade-offs among stakeholders who have different perceptions, interests, and intentions. Good decision making processes are necessary to establish objectives for the local management in particular.

Good decision-making processes incorporate the following characteristics:

a) All interested parties (particularly indigenous and local communities) should be involved in the process;

b) It needs to be a clear how decisions are reached and who the decision maker(s) is (are),

c) The decision-makers should be accountable to the appropriate communities of interest;

d) The criteria for decisions should be appropriate and transparent;

e) Decisions should be based on, and contribute to, inter-sectoral communication and coordination.

Some prerequisites for all stakeholders to develop good decisions are:

a) have access to accurate and timely information and the capacity to apply this knowledge; directly represent themselves or adequately represented by someone else;

13 The 'Further Development of the EsA'' Workshop (held in Isle of Vilm in 2002) concluded that the focus of the EsA principles is rather how to contribute to and affect livelihoods, than the biodiversity within them. However, it also stated that EsA could not adequately address the equity and livelihoods issues, but rather is an effective framework to analyze specific cases (Wit 2003). Smith and Maltby (2003) carried out an analysis of the extent to which EsA principles can feasibly be applied to current practices (based on lessons-learned); with a first attempt at examining how the CBD understanding of the EsA might be translated in operational terms (IUCN, PROFOR, World Bank 2004). However, due to high variability of local conditions in different countries in which management is realized, a single prescription cannot be applied. Therefore, flexibility is required with regards to operating the 12 principles and 5 guidance of EsA (Wit 2003). Shepherd (2003) proposed 5 steps for operationalization through clustering and sequencing the principles, considering: 1) area and stakeholders, 2) ecosystem structure, function, health and management, 3) economic issues, 4) adaptive management over space, to cover impact on adjacent ecosystem issue, and 5) adaptive management over time, as projection of long term goals and flexibility with regard to ways of reaching them.

b) have an equitable capacity to be effectively involved, and the ability to participate in the processes;

c) the decision-making process compensate inequities of power in society, particularly for those who are normally marginalized (e.g. women, the poor, indigenous people);

d) it is clear who are the decision-makers, how the decisions will be taken (what process will be used), what are the criteria for the decision in law, and what is the overall policy guidance the decision must fit in;

e) recognition of interests includes the full range of decisions over time and space and levels;

f) existing societal mechanisms are used (where possible), or new mechanisms built up that are compatible with existing or desired societal conditions;

g) decision-makers are accountable to the appropriate communities of interest;

h) the capacity to broker negotiations and trade-offs, manage conflicts among relevant stakeholder groups in reaching decisions about management, consider use and conservation of biological resources is developed;

i) appropriate mechanisms that will be able to be implemented over the long term, i.e. policy, legislative and control structures are in place;

j) appropriate assessments to analyze effects of ecosystem management practices on society are presented.

If these legal mechanisms and set of supportive provisions have been established, mutual communication and participation as well as collaboration can be developed progressively for all parties. The decision outcome can then be seen as societal choice.

Principle 4 - Incentives, disincentives and internalization of environmental costs and benefits:

The greatest threat to biological diversity basically comes from the replacement by alternative systems of land use. It often arises through market distortions which undervalue natural systems and populations. Thus, adequate economic mechanisms should be established properly, like incentives for conservation and environmental restoration to improve the diverse of nature, or penalties for those who generate pollution and environmental-costs. Furthermore internalize costs and benefits in the given ecosystem are necessary.

Ecosystem goods and services are frequently undervalued in economic systems. Even when valuation is complete, most environmental goods and services have the characteristic

of "public goods“, which are difficult to incorporate into markets. Hence, economic systems need to be redesigned to accommodate those values into market prices. Addressing the issue of market distortions that adversely affect biodiversity will require establishing dialogue with other sectors. Deriving economic benefits is not necessarily inconsistent with attaining biodiversity conservation and improvement of environmental quality.

Principle 10 - (Forest) ecosystems benefits for local communities:

Looking at economic benefits that rely on ecosystem functioning, one has to consider that those usually drain off to the national or international level while the environmental problems do accrue locally. Local environmental management bares the chance to develop a better management strategy to gain local benefits. As expected in the Agenda 21 scenario, local values and capacities as well as problems can be localized, made visible and become managed. In the autonomy system, the sectoral programme activities are expected to be easier to get adjusted and integrated.

The array of functions provided by forests, including biological diversity provides the basis of human environmental security and sustainability. In the forestry sector, the main function of a forest area is first determined. Other functions can be considered as long as they will not compromise the defined main function. In practice, functions should reward the stakeholders who are responsible for their management. This requires, inter-alia:

a) capacity building, especially at the level of local communities that shall manage biological diversity and their ecosystems;

b) proper valuation of ecosystem goods and services;

c) compliance with provisions of the CBD recognition through local incentives for good management practices as far as necessary (Wit 2003).

In the past, here has been a tendency to manage components of biological diversity either as protected or non-protected. There is a need for a shift to more flexible performance, where conservation and use are seen in context and the full range of measures is applied in a continuum from strictly protected to human-made ecosystems. Thus, integration of biological diversity conservation and sustainable use basically means to achieve conservation objectives while considering the local communities needs.

Principle 11 – Relevant information and transparency as basis for capacity building and explicitness of participation:

Information from all sources including indigenous and local knowledge as well as better knowledge of ecosystem functions in general concerning an area are essential to arrive at effective ecosystem management strategies. Shared information between all stakeholders

and actors should be considered. Assumptions behind proposed management decisions should be made explicit and checked against available knowledge and views of stakeholders.

Ecosystems can be viewed at various scales and from different perspectives. To consider all relevant, available and missing information is important for designing and implementing appropriate management. Different information sources will address issues at different levels, providing complementary perspectives to support integrated management. Appropriate mechanisms should be developed to document the relevant information from all relevant disciplines (including natural and social sciences) and from relevant knowledge systems, particularly those based on local and traditional practices and make them all more widely available. Good management also depends upon improving the information base and scientific understanding of ecosystems through the promotion, implementation and application of research and integrating this information into decision-making.

Principle 12 - Communication and collaboration at all levels and between all relevant stakeholders:

Most problems of biological-diversity management are complex, with many interactions, side-effects and implications, and therefore should involve the necessary expertise and stakeholders at the local, national, regional and international level. The ecosystem approach should provide a framework for fostering greater involvement of all relevant stakeholders as well as technical expertise in planning and carrying out coordinated activities, sharing management resources, or simply exchanging information.

Different sectors of society view ecosystems in terms of their own economic, cultural and societal needs. EsA is trying to connect and mediate those needs with respect to biological diversity. For biodiversity strategies and action plans and their integration involves all relevant stakeholders and calls them for inter-sectoral and interdisciplinary communication and cooperation at all appropriate levels, because development efforts are usually changing the environment.

Table 2.3. Ecosystem approach principles grouped into three issues

Principles in the CBD's Ecosystem Approach		Theme
A. Adaptive Management issues		
1	The objectives of management of land, water and living resources are a matter of societal choices	Laws and Regulations
2	Management should be decentralized to the lowest appropriate level	Structural organization to the lowest appropriate level
3	Ecosystem managers should consider the effects of their activities on adjacent and other ecosystem	Environmental Impact Assessment
7	The EsA should be undertaken at the appropriate spatial scale	Spatial and temporal scales
8	Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term	Long term management goals
9	Management must recognize that change is inevitable	Adaptive management
B. Area and Ecosystem structure, functions and integrity issues:		
5	Conservation of ecosystem structure and function, to maintain ecosystem services should be a priority.	Forest arrangement to maintain ecosystem services
6	Ecosystems must be managed within the limits of their functioning.	Precautionary approach to maintain ecosystem functioning
10	The EsA should seek the appropriate balance between and integration of, conservation and use of biological diversity	Zonation and multi-functionality of forests
C. Economic and Stakeholder issues		
1	The objective of management of land, water and living resources are matter of societal choice	Societal choice and democratization
4	There is usually a need to understand and manage the ecosystem in an economic context and to: Reduce market distortions that adversely affect biological diversity Align incentive to promote biodiversity conservation and sustainable use, and Internalize cost and benefits in the given ecosystem.	Incentive, disincentive mechanisms and internalization environmental cost and benefits.
10	The EsA should seek the appropriate balance between and integration of, conservation and use of biological diversity	Forests benefits for local communities.
11	The EsA should consider all forms of relevant information	Relevant information and transparency as basis for capacity building and explicitness of participation
12	The EsA should involve relevant sector of society and scientific disciplines.	Communication and collaboration at all level and relevant stakeholders.

3. Procedure and Methods

3.1. Research Procedure

The Table 3.1 shows the procedure for this research in chronological flow.

Table 3.1. Research Procedure

Phase	Aim	Objective	Data Source
Explorative	• To observe objectively the selected study area • To observe major ecological problems and challenges of the area, with respect to forestry issues	• To formulate problems and develop questions • To formulate the objective and the scope	• Own observations and experiences (reflective) • Respective development reports/discussion paper, maps, various running projects/ programmes reports, discussion with various key officers • Literature
Conceptual Procedure and Method	• To develop research procedures and data sources • To select appropriate methods for analysis	• To develop/modify a guideline for research assessment • To present methods of analysis respecting research questions	• Literature about research methodology particularly about public policy decisions • The developed matrix from Forest Land Rehabilitation (FLR) • programme • CBD's EsA Principles
Theoretical Review	• To support modification of the assessment matrix from the Forest Land Rehabilitation/FLR programme • To define principles for evaluation of the determined problems	• To construct theoretical background • To give understanding of arguments for reasoning	• Literature i.e. forest functions, ecosystem management, forestry, ecological landscape, management system, various discussion texts about SFM and EsA
Evaluative Legal Provisions	• To understand the effective legal instruments in forest management practices	• To present legislation hierarchy, text of legislation provisions and gaps (adequacy)	• A set of legislation relating to the research theme
Case Study	• To understand the situation and the natural characteristics of the study area • To give various examples of forestry practices within forestry sector itself and other sectoral development practices	• To describe the ecological dynamics of the study area • To present sectoral development policy and practices relating to ecological functions of forest in the study area and its collaboration	• Sectoral policy, programmes, and projects reports • Interview with key government officers and the involved professional consultants in some development projects • Field observation and secondary data i.e. assessment reports from independent institutions
Synthesis	• A comprehensive evaluation based on findings, approach and theoretical review	• To answer research questions.	• EsA Approach • SWOT Analysis
Final Conclusion	• To point out the research output in short statement	• To present summary or restatement of the research study	• SWOT analysis output
Recommendation	• To state the possible improvement	• State author's opinions/ judgement as well as critic from the research	• Author's knowledge

3.2. Explorative Phase

In this phase, the author was exploring key topics for the research related to major ecological problems in Indonesia. The Bengawan Solo River Basin was selected as the study example to demonstrate the specific roles of forests and forest management. This phase started with observations and explorations of the study area, which is very well known by the author. The respective observations and experiences were discussed with various key government officers and the responsible bodies. Considering the results of discussions and further relevant information, an objective description of the area was elaborated. Various development/programme reports from the government were studied to determine substantial topics. This was followed by also studying up-to-date publications. The aim of this step was to understand the main problems of the area with respect to forests and the natural environment, and to confirm the research questions, the objective, and the scope.

Doty (1983 in Danim 2000) explains that a case study approach is appropriate to develop arguments for a thesis or research questions. In the present case, it was essential to reveal possible causes for the declining environmental quality and to identify the role and function of forests and their management. Burton (1979 in Danim 2000) identified the first study phase as a *'focussed-synthesis method'* that combines information from the most relevant publications and from one's own experience, as well as from discussions with competent individuals. It is obvious that this approach is different from what a 'traditional literature review' does. The focussed synthesis method points out the importance of discussion results or gaps that can be found in publication material. The literature review is included in this study to gather further required data or information. The outcome is the formulation of fundamental problems, questions and objectives that underlay the research.

3.3. Conceptual Phase

3.3.1. Procedure and Method

In this phase, the major aims and tasks for assessment were defined, and case studies were selected. Representative cases from different sectors were chosen to illustrate their collaboration with the forestry sector. To obtain the required data or information, each case study employed an appropriate method for data acquisition. Finally a SWOT analysis was employed for the comprehensive evaluation.

3.3.2. Theoretical Review

Based on the formulated problems, questions, and objectives from the first phase (chapter 3.2), the theoretical review was iteratively developed. For this purpose, further literature was studied to select an appropriate frame for the evaluation, namely the CBD's Ecosystem Approach (EsA).

3.4. Evaluative Phase

3.4.1. Materials

3.4.1.1. Legal Provisions

The aim of this step was to study and assess the current national legal provisions down to the basic administrative level, which was necessary, to understand how things are regulated.

The respective steps were as follows:

1) taking an overview of the relevant legislation,
2) collecting the respective legislation texts from the national level to the lowest necessary level,
3) assessing the gaps that exist, and
4) Summarizing the output.

The results are presented as a part of the research findings (Chapter 4 and 6.1).

3.4.1.2.Case Studies

A case study approach was adopted after the subjects of the research had been defined. According to Danim (2000), the case study method provides the following advantages:

- it gives a basic framework for further actions because of the relevance for specific cases,
- it focuses on a specific issue and may serve as a source for creating new questions and hypotheses for further research,
- the results can be useful to give another perspective which differs from current generalizations.

However, disadvantages do also exist, namely:

- the research is less representative because the subject and/or unit of research are limited,
- generalization can only be developed afterwards when a wider range of cases have been considered,
- case studies risk subjectivity during sample selection, and
- inaccuracy can result from data that is only analysed locally.

a) Case Study Selection

The selected cases had to be focussed on forest functions, particularly with regard to ecological means and their importance in development. Apart from the forestry sector itself, forest functions were considered as relevant with respect to the development of: water supply, agriculture, infrastructure and settlement. The study cases were all chosen within the Bengawan Solo River Basin (later: BS Basin) as the designated study area.

The concept was to get a complex description or picture of the multifunctional relevancies of the forest in the area, not only under natural conditions but also including the human systems in place.

The selected case studies include:

(1) Forestry and Watershed Management: Forest Land Rehabilitation Program for the Wonogiri Reservoir.

(2) Forestry and Segregative Nature Conservation: The Designation of Conservation Areas.

(3) Forestry and Integrated Nature Conservation issues: SFM Certification of (Teak) Plantation.

(4) Plantation Forestry and Local People's Benefits: Community Forestry and Social Forestry.

(5) Urban and Transportation Development and Forestry: The Strategic Road Infrastructure Project (SRIP).

(6) Local Government: Regional Development and Urban Forestry.

Site observations, interviews and discussions with experts were taken during three months of the third quarter in 2004. For data actualization purposes, a further study and field observation was carried out at the end of 2011 and early 2012.

b) Data and Information Acquisition

Site observation was practiced to figure out the current conditions as a result of the development process, together with discussions conducted with the key personnel for forest planning in Java (*BPKH IX* and *Perhutani)*; for FRL programme/watershed level (*BRLKT-Solo)*; and for public services (*DepKimpraswil*). The latter has also involved professional consultants.

Two types of research methods were applied for data and information acquisition purposes, namely:

(1) Qualitative method

This method is characterized by selecting the source of information and identifying the work process to describe the overall phenomena. It is characterized also as an inductive method of reasoning to obtain or discover general laws from particular facts. It was adopted in the discussion phase involving several competent individuals, in the explorative phase ('focussed-synthesis method') and in the evaluative phase following Burton 1979 (in Danim 2000).

(2) Secondary data analysis method

Secondary data has been acquired from the selected relevant project reports as objective evidences of the planning activities. Hyman (1972 in Danim 2000) presents the benefits of using this method rather than collecting original data. Inter-alia these are: saving time and money, less invasion-of-privacy objections as well as the ease of making comparative analysis. This method also has disadvantages, including: the necessary data may simply not be available, and the available data may contain errors that the researcher cannot detect, due to hidden political or bureaucratic interests, as a few examples.

To reduce such errors, in depth interviews and discussion implementing the snowball-approach, as well as site observations and crosschecks of data from the different sectors were applied. The advantage of this technique is to better understand the decision processes in management units' development (Danim 2000).

c) Data Stratification for Assessment

The guidance for data collection was inspired by the developed matrix for Forest Land Rehabilitation/FLR (MoF Decree no.20/2001). However, a modification was needed following the requirements for EsA principles. There are four activities in a management process that were researched to refine the dimensions of the FLR criteria combined with the FAO's recommendation on CBD (**), namely:

- planning (**evaluate, adjust, assess the problem)
- management and organization (**design action)
- implementation
- control and monitoring

Content details of this matrix are given in Table 3.2.

3.4.2. Synthesis

The *SWOT analysis* was used for the final synthesis and assessment. It is a structured planning method to evaluate the internal strengths and weaknesses/limitations as well as external opportunities and threats that are usually associated to a project. SWOT is also an instrument to develop appropriate management strategies. It involves specifying the objectives of the project and identifying (the internal and external) factors that are favourable and unfavourable to achieve that objective (Hill and Westbrook 1997).

Concerning this particular investigation,

- Strengths are characteristics of the current forest management that give advantages for EsA implementation.
- Weaknesses (or limitations) are characteristics of the forest management that give disadvantages compared to others.
- Opportunities are external chances to improve the performance of the forest management with respect to the natural environment.
- Threats are external factors that could cause trouble for the EsA implementation (natural, socio-cultural, political, administrative etc).

Identifications of SWOT are essential because they provide well structured information for the development of appropriate management strategies and for the planning of subsequent steps to achieve the selected objectives.

The following relevant questions were developed for the SWOT Analysis:

Strengths (characteristics of the current forest management that give advantages for EsA implementation)

- Which EsA principles have been already recognized and/or implemented?
- What steps have been taken by the forestry sector with respect to the CBD's EsA principles i.e. under existing forestry laws or by forest planning and implementation?
- Which ecological forest functions have been considered and supported?

- What kind of scientific support has already been provided? To what extent can forest workers influence the project outcome?
- What types of resources have already been used for collaboration with other sectors or communities?

The answers to these questions may be useful for the decision makers with respect to the design of more realistic policies concerning forestry development, in the context of integrated development that underlies the ecosystem approach.

Weaknesses (characteristics of the forest management that give disadvantages compared to others)

- Which EsA principles have not yet been recognized (i.e. by laws) or not well implemented?
- What constraints face the planning, management, implementation and monitoring processes?
- Are there any disadvantaged stakeholders? If yes, what kind of alternative approaches can be introduced?

Identification of the weaknesses of the current forest arrangement may be useful as the starting point for improvement.

Opportunities (external chances to improve the performance of the forest management with respect to the natural environment)

- What kinds of opportunities do exist for forest (re-)arrangement based on ecological functions when the CBD's EsA is applied - including, inter-sectoral collaboration?
- What types of opportunities can be identified for foresters and the communities?

The identification of opportunities for forest function planning can be useful to enable improvements and to reduce the weaknesses and limitations of the current forestry practices.

Threats (external factors that could cause trouble for the EsA implementation)

- What kind of obstacles had to be faced when implementing the CBD's EsA in forest management?
- What kind of threats might appear concerning the interests of stakeholders or biodiversity when the CBD's EsA will be fully implemented?

This analysis allows to anticipate obstruction and to formulate better adapted and more realistic policies and strategies concerning ecological improvement through forest functions arrangement.

Table 3.2. Matrix for the Research Assessment

Issues	Management (Organisation, Adaptive Management) EsA Principles: 1,2,3,7,8,9			Spatial (Eco-Structure, Function and Integrity) EsA Principles: 5,6,10			Stakeholder and Economic EsA Principles: 1,4,10,11,12		
	Management System	Authority	Cooperation Mechanism	Unit Management	Ownership	Function	Information	Participation	Incentive / Disincentive
Dimension	Planning								
	Management and Organization								
	Implementation								
	Control and Monitoring								

3.5. Final Phase

3.5.1. Conclusion

The conclusion section is part of the evaluative phase. It is a condensed restatement of what has been elaborated in the study. It gives answers to the research questions based on the given case studies and the analysis will be shortly stated. The primary conclusions summarize the current management of the forest functions in the study area with respect to EsA, while the secondary conclusions highlight the major constraints and dilemmas of forest management when EsA is fully applied.

3.5.2. Recommendation

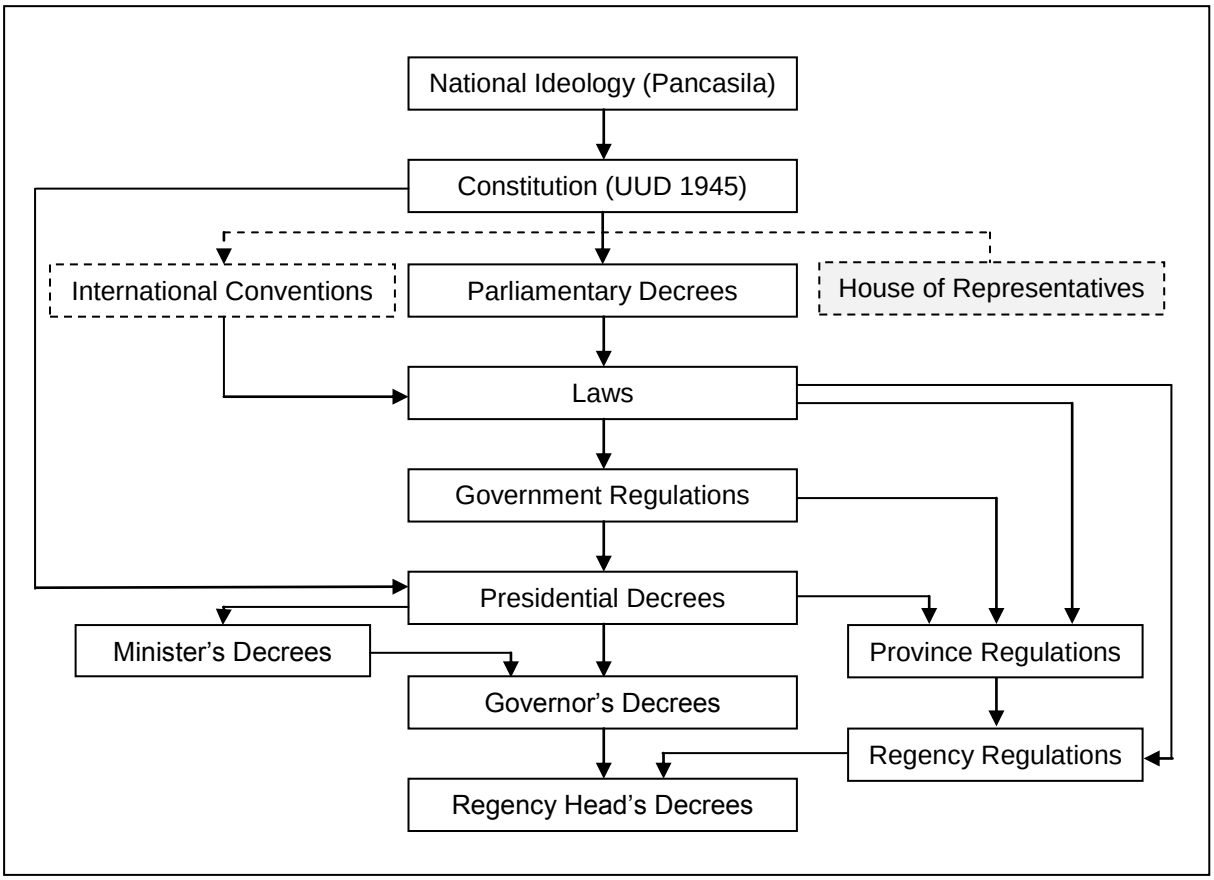
The last phase represents a normative approach where recommendations are delivered, how to maintain forest ecosystems with respect to their ecological functions and to initiate forest enhancement, particularly in fragmented forest areas, including urban areas. Therefore rehabilitation/reforestation programmes can be more meaningful in terms of ecologically relevant aspects, particularly with regards to improving biological diversity and human livelihood in the study area. The recommendation section also states the author's final opinion and judgement as well as a criticism of the study.

4. Regulations Concerning the Ecological Functions of Forests

4.1. The Hierarchy of Indonesian Legislation

The following hierarchy of legislation serves to show the order of the Indonesian regulation system from the highest to the lowest level.

Figure 4.1. The Hierarchy of Indonesian Legislation Scheme



When reviewing a set of cognate legislation, two aspects are necessary to look at: first, the relevancy between legislations, formulated laws and further policies from the technical department sectors; second, the substantial content of the regulations and whether they provide adequate processes and measures with respect to the formulated strategic goals.

4.2. General Regulations Concerning Land Use and Natural Resource Management

In practical land use management, attributes like land cover and land use types, ecosystem types, natural richness, demographic conditions etc. constitute the important key information for planning. However, planners and designers, ecologists and conservationists as well as different land users have different views and visions on how a specific landscape should look like. Different professionals attempt to shape the future landscape in different ways depending on their different sectorial goals. The various ways of viewing the ''ideal''

future of a piece of land will result in diverse consequences. The respective legislative system and policies for spatial planning should provide norms and standards how these different visions can be harmonized and conflicts be solved. Thus, the legal basis and its historical background for supporting and directing land use changes into the current and future conditions will be presented at first.

Basically the Constitution article 33 (3) determined that all natural wealth: earth, water and their resources, are controlled by the state and shall be safeguarded for the utmost welfare of the people. The constitution clearly appoints the government as the institution that controls natural resources. In practice, this responsibility is subdivided into different administrative sectors. The Parliamentary Decree No. I/1998 which implemented the National Spatial Development Plan determined that lands shall have social functions and their utilities should raise the people's prosperity. To achieve this goal, a coordination of the various land uses is considered as necessary to guarantee their sustainability and to avoid damage to the interests of the community and development. The Parliamentary Decree No. IX/2001 on the Agrarian Reform and Natural Resource Management acknowledges that conflicts in development can appear. To minimize them, the management of natural resources should be optimal, fair, sustainable and environmentally friendly. In addition, the Parliamentary Decrees No. XV/1998 and No. IV/2000 emphasize that development should encourage people's participation to meet the developmental objectives. For this purpose, local governments have the responsibility to empower their local communities.

In line with the development of environmental laws and regulations, Indonesia has experiences with a long period of Dutch colonialization. Legal products that relate to the protection and management of natural resources can be identified within laws and regulations which were enacted by the Dutch government. The current development of the Indonesian Environmental Law has been influenced by the outcomes of the United Nations Conference on Human Environment in 1972 (also known as the ''Stockholm Declaration''), that initiated a modern global environmental management (Silalahi 2001). The Stockholm Declaration (principle 2) emphasized 'careful planning or management as appropriate' for the natural resources including biodiversity, especially representative samples of natural ecosystems.

Indonesia has ratified this declaration which, as a consequence, has affected further development policies. Ten years after the conference the Government of Indonesia enacted a Law on Environmental Management No. 4/1982 for the first time.

This change of concern was also implemented in the forestry law. The previous Law on Forestry No. 5/1967 emphasized the control of domestic and foreign investment in forests. This was replaced by a regulation that is now concerned with the impact of management

activities on the natural environment. Such circumscription also occurred in many other regulations concerning natural resource management and led to the establishment of the Ministry for Environment and Development Control in 1978 (now: The Ministry for Environment/MoE). This can be seen as a particular direct response to the Stockholm Declaration in order to control further development in an environmentally sound manner.

In 1992, the United Nations initiated the Earth Summit known as The United Nations Conference on Environment and Development conducted in Rio de Janeiro with the purpose to reaffirming the Stockholm Declaration. Principle 4 of the Rio Declaration states that in order to achieve sustainable development, environmental protection shall constitute as an integral part of the development process and cannot be considered in isolation from it. In 1997, the Government of Indonesia replaced the Environment Management Law No. 4/1982 by the Law No. 23/1997 which again was repealed and replaced by the Law No. 32/2009 on Environmental Protection and Management.

In 1994, the Government of Indonesia ratified the UN-CBD and enacted the Law No.5/1994. This Law carries further consequences for the country to implement the developed principles. An important product of the Convention was a concept for action following the ecosystem approach (EsA) and encompassing twelve principles and five points operational guidelines of EsA were endorsed at the fifth meeting of the Conference of the Parties/COP in the year 2000 and refined at the sixth meeting of the COP in 2002.

The implementation of EsA principles considers the local conditions including the legal framework. The following table names selected current legislations that are relevant for the study:

Table 4.1. Legislation concerning Environmental Management and Forest Functions

Legislation's Hierarchy	Relevant Legislations	Contents
National Ideology ('Pancasila')	• Principle No. 2 • Principle No. 4 • Principle No. 5	• General principles of humanism and fairness • Consultative democracy • Social justice
Constitution	• Article 18; 1 to 7 • Article 18A; 1, 2 • Article 33; 3 to 5	• Regional government • Relation between central and regional government • Authority over natural resources, equity and prosperity
Parliament Decree	• II/MPR/1993 • I /MPR/1998 • XV/MPR/1998 • IV/MPR/2000 • IX/MPR/2001	• National Direction for Development (GBHN) • National Planning and Spatial Planning • Regional Autonomy • Regional Governance • Agrarian Reform and Natural Resource Management
Law	• 5/1990 • 26/2007 • 5/1994 • 32/2009 • 41/1999 • 22/1999 • 32/2004	• Conservation of Living Resource and their Ecosystem • Spatial Planning • Ratification of UN-CBD • Environmental Protection and Management • Forestry • Regional Governance • Local Governance
Government Regulation	• 43/1993 • 69/1996 • 26/2008 • 62/1998 • 28/2011 • 25/2000 • 34/2002 • 63/2002 • 16/2004 • 30/2003 • 44/2004	• Road Infrastructure and Traffic • People's Participation in the Spatial Planning Process • National Spatial Planning • Delegation Forestry to the Local Governments. • Nature Reserve and Nature Preservation • Central Authority and Local Authority (province). • Forest Planning and Utilization in Designated Forests. • Urban Forests. • Management on Land Use • *Perhutani* (The forest state company for Java) • Forestry Planning
Presidential Decree	• 32/1990	• Protected Areas
Ministry (of Forestry) Decree	• 830/1992 • 464/1995 • 618/1996 • 62/1998 • 204/1998 • 63/2000 • 123/2001 • 20/2001 • 52/2001 • 665/2002 • 7211/2002 • 8206/2002 • 159/2004	• Planning System for Forestry • Management in Protective Forests • Management for non-protected Wildness population • Delegation of responsibility in forestry sector from central to local government. • Management and Organization of Conservation Units *(BKSDA & KSDA)* • Management Procedures between Forestry Department and *Perhutani* • Management and Organization in the Forestry Department. • General Model, Standard and Criteria for Forest and Land Rehabilitation • Manual Management for Watershed • Management and Organization in Watershed Unit *(BPDAS)* • Manual for Forest and Land Rehabilitation plan • Standard and Criteria for Forest Extension. • Ecosystem Restoration in Production Forest

4.3. Regulations Concerning Biodiversity and Wildlife

The National Guidance for development - Parliament Decree No. II/MPR/1993- enacted that the UN-CBD shall be the fundament for all development, underlining the importance of ecosystems functioning for health, social and economic life. The Convention entered into force through the ratification of UN-CBD Law No. 5/1994.

The stipulated Law No. 5/1990 on Conservation of Living Resources and their Ecosystem for in-situ conservation was used as one of the basic instruments to fulfill the requirements of the Convention. The classification of in-situ conservation and its description is given below.

Table 4.2. Sphere Classification based Functions according to Law No. 5/1990 on Conservation of Living Resources and their Ecosystem

Sphere Category	Sub-Category	Main Functions
Nature Reserve Sphere /NRS *(Kawasan Suaka Alam)*	Nature Reserve *(Cagar Alam)*	Preserve unique natural flora, fauna and their ecosystem, or specific ecosystem.
	Game Reserve *(Suaka Margasatwa)*	Preserve unique animal species and/or fauna diversity and their habitat.
	Biosphere Reserve *(Cagar Biosphere)*	Preserve natural ecosystem, unique ecosystem and/or degraded ecosystem, for research and education
Nature Preservation Sphere /NPS *(Kawasan Pelestarian Alam)*	National Park *(Taman Nasional)*	Preserve natural ecosystem, zonation based-management, for research, science, education, supporting agriculture, recreation and tourism.
	Grand Forest Park *(Taman Hutan Raya)*	Collect native and non-native flora and /or fauna, for research, science, education, supporting agriculture, culture, recreation and tourism.
	Nature Recreation Park *(Taman Wisata Alam)*	Nature recreation and ecotourism.

Note: NRS and NPS have an identical function, namely: sphere with a unique characteristic with main function to preserve flora and fauna diversity and life supporting system.

According to Ministry of Forestry's Section for Law and Technical Cooperation, the Government Regulation No. 68/1998 on Management of NRS and NPS has been replaced by No. 28/2011 because the previous provision was inappropriate to adopt the change of social demands that were caused by the environmental changes (personal communication 2012).

Table 4.3. Sphere Classification by Functions according to Government Regulation No. 28/2011 on Management of Nature Reserve and Nature Preservation

Sphere Category	Sub-Category	Main Function
Natural Reserve Sphere	Nature Reserve	Preserve unique natural plant species and/or flora diversity, including their ecosystem.
	Game Reserve	Preserve unique natural wild animals and/or fauna diversity, including their habitat.
Nature Preservation Sphere	National Park	Natural ecosystem, management based zonation for research, science, education, supporting agriculture, recreation and tourism.
	Grand Forest Park	Preserve native and non-native flora and fauna diversity and their ecosystem to avoid extinction, and to maintain their balance.
	Nature Recreation Park	Ecotourism and recreation.

The ratified UN-CBD Law No. 5/1994 clearly requires that management of biological diversity does not only concern the protected areas but also includes the areas outside. It is seen as important to promote environmentally sound and sustainable development, particularly in the areas adjacent to the protected areas and to ensure their conservation and sustainable use. In degraded ecosystems, management strategies for rehabilitation and restoration efforts including the promotion and recovery of threatened species shall be defined and fixed in a plan.

The government has obligations to promote and to encourage the understanding of conservation importance by introducing appropriate policies, programmes, procedures and arrangements for proposed projects, to avoid or minimize negative impacts. On the other side, the CBD's preamble has recognized that many local communities in which follow their traditional lifestyle directly depend on biological diversity. It requires all contracting parties to facilitate the exchange of information and to promote technical and scientific cooperation. Concerning the adjacent areas, the Environmental Protection and Management Law No. 32/2009 has already initiated ecoregions as a basis for inventarisation and environmental planning.

The previous Law No. 4/1982 on Environmental Management had been the first law in Indonesia that introduced environmental issues regarding biological diversity, protected zones and forest conservation. At that time, a draft for 'Natural Resource Conservation and Ecosystems' was also in preparation, but the approval was only attained in the 1990's. However, the necessity to integrate ecological values in the development had been promoted and started in the five yearly national development plans 1989-1994 (*REPELITA* V). The document recognized the importance of Indonesian biological diversity as essential

for ‘The Survival for the Nation’. In parallel, the Conservation of Living Resources and their Ecosystem, Law No. 5/1990 was issued. One year later the ‘Indonesian Country Study on Biological Diversity’ was carried out. Its goal was to improve the accuracy and realism of the global assessment of the total benefits, the current management costs, as well as the requirements for biodiversity conservation and rational use to facilitate a political agreement on financial needs (Silalahi 2001; CBD 2004a).

In 1993, the Indonesian State Ministry for Environment issued the ‘Indonesian National Strategy on the Management of Biological Diversity’. As a follow up to this strategy the Indonesia National Planning and Development Board (*BAPPENAS*) issued an action plan, which was called ‘The Biodiversity Action Plan for Indonesia’ (BAPI). This should be followed by all sectors that are involved in the management of biological diversity in Indonesia to guarantee the success of the integrated national program on biological diversity. The BAPI 1993 prioritized in-situ conservation measures, inside- and outside protected areas as well as ex-situ conservation (MoE 2009). Referring to CBD (2004a), these three policies, namely Law No. 5/1990, Law No. 5/1994 and BAPI 1993, if implemented effectively, may have become important tools for sustainable biodiversity management for Indonesia.

The national management strategy emphasized the importance of reliability in analyzing those factors that cause the reduction or the loss of biodiversity, including its management. It was directed to maintain the usage of biodiversity for present and future generations, the conservation and the scientific assurance of sustainable use. Again, the strategy for action concerned in-situ conservation like in terrestrial parks and protected areas; in-situ conservation outside the protected areas network, like in production forests, wetlands, agriculture lands, coastal and marine areas; plus ex-situ conservation.

Remarkably, the BAPI 1993 was established prior to the UN-CBD Convention, which was put into force through Law No. 5/1994. To respond to this, the GOI updated the BAPI by developing a new national BAPI with ‘Indonesian Biodiversity Strategy and Action Plan’/ IBSAP in the year 2003 (MoE 2009). This revised action plan aimed to achieve 5 goals, namely: 1) attitude and behaviour change of the Indonesian individuals and society towards biodiversity issues, as well as the legal instruments governing existing institutions; 2) application of scientific and technological inputs and local wisdom; 3) implementation of balanced conservation and sustainable use of biodiversity; 4) strengthen institutions and law enforcement; and 5) resolve conflicts concerning natural resources.

To guide these goals, a participative process and awareness rising of the current environmental issues were promoted. At regional level, programs were formulated based on bioregions. Furthermore regional programs were translated into local frameworks that could serve as guidelines for the local government to develop their own programs and action plans.

These programmes and their results have been presented in the Fourth National Report concerning the CBD (MoE 2009). According to this report, Indonesia has still faced some constrains in implementing the Convention during the transformation phase between 2003-2009, among others: lack of support for the implementation, lack of communication and coordination among stakeholders, no mechanism or setting to ensure the implementation in different sectors, lack of awareness, and limited effort in monitoring and integrating data and information that can be used for preparing the policy in the implementation of the Convention. All these deficits do still compromise appropriate ecosystem management, not only in protected areas but also in the areas outside.

4.3.1. Regulations Concerning Forestry

The former provision on Forestry (Law No. 5/1967) mainly stipulated investments in the forestry sector. This was no longer compatible with the global and national principles concerning the environment nor could it be adapted to the decentralization process. The current Law No. 41/1999 on Forestry (article 18) determines that forest administration under the Ministry of Forestry has to ensure to upkeep forested areas proportionally distributed, particularly for environmental, social and economic functions for local communities. The total forested area shall cover a minimum of 30% of the total watershed and/or island. Environmental sustainability and its improvement shall be considered particularly with respect to the carrying capacity of watersheds.

Basically, the Forestry Minister is supported by four Directorate Generals/DGs as sub administration, namely DG of Human Resource, DG of Forestry Planning, DG of Watershed Management and Social Forestry and DG of Forest Protection and Nature Conservation. These DGs have been structured by considering the practical management of diverse functions of the forest as the basis for forest management intervention.

The DG of Forest Protection and Nature Conservation is deconcentrated[14] to the lower level called the Nature Conservation Agency *(Balai Konservasi Sumberdaya Alam)*. The Nature Conservation Agency is an operational unit that manages conservation areas, particularly game reserves *(Suaka Margasatwa)*, nature reserves *(Cagar Alam)* and nature recreation parks *(Taman Wisata Alam)*. This Agency also has responsibilities to control and monitor the distribution of protected flora and fauna in its area.

For watershed management, the Unit for Watershed Management has responsibilities to plan, control and monitor the respective watersheds concerning water and soil preservation as well as rehabilitation efforts.

[14] Deconcentration is defined as a transfer of power to local administrative offices of the central government, in which the transfer does not include the authority to make decisions; it is also labeled as administrative decentralization (Parker 1995).

The development of the classification of forests by functions is shown in Table 4.4 and Table 4.5.

Table 4.4. Forest Classification by Functions according to Law No. 5/1967 on Forestry

Category	Sub-Category	Function
Production Forest	Permanent Limited Convertible	Generating forest products.
Protective Forest	--	Protecting hydrology, preventing flood and erosion, maintaining soil fertility.
Nature Reserve Forest	Nature Reserve	Preserve unique flora and fauna; for science and culture.
	Game Reserve	Preserve unique animals' habitat, for science, culture and as a national identity.
Recreation Forest	Recreation Park	unique nature beauty, for recreation and culture
	Hunting Park	recreation hunting

Table 4.5. Forest Classification by Functions according to Law No. 41/1999 on Forestry and GR No. 34/2002 on Forest Planning and Utilization in Designated Forest

Category	Sub-Category 1	Sub-Category 2	Main Function
Production	Limited	---	Generating forest products via selective/limited logging scheme.
	Permanent	---	Generating forest products.
	Convertible	---	Generating forest products but spatially reserved for development other than forestry.
Protective	----		Protecting life supporting systems for hydrology, preventing flood, controlling erosion, preventing sea water intrusion and maintaining soil fertility.
Conservation	Nature Reserve	Nature Reserve	Preserve biodiversity as well as respective ecosystems; also functions as an area for life supporting systems
		Game Reserve	
	Nature Conservation	National Park	Protect life supporting systems, preserve biodiversity and sustain utilization of natural resources and their ecosystem
		Grand Forest Park	
		Nature Recreation Park	
	Hunting Park	----	Recreation hunting

The current Law No. 41/1999 on Forestry presents two new sub-categories under nature conservation, namely National Parks and Grand Forest Parks.

In the forestry administration context, protection has two meanings, namely:

a) protection of forests to prevent any destruction arising from humans, animals, fires, natural hazards, pest and diseases; and

b) protection of the established forest management frame concerning rights, borders, products, investments etc. ensuring that forest utilization is allowed for the right- or license holder.

As shown in Table 4.5 above shows that designated forests for production purpose are divided into three classes, according to the allowance level of exploitation intensity. Under these three production forest classes, function for 'special purposes' can be introduced to pursue public interests as far as they do not change the main function. It possible to rededicate the main function of a forest area but it should be based on integrated research.

In addition, the Forestry Law does also recognize 'urban forest'. Its arrangement is stipulated separately in Government Regulation No. 63/2002 on Urban Forest (see Appendix 2).

The Government Regulation No. 44/2004 deals with forestry planning at all levels: national, regional, watershed and management unit level. The planning shall include a forest inventory to obtain data and information about the resources, natural richness and their environment in a comprehensive way. The results are used as a basis for the area allocation and announcement, as well as for the arrangement of the permitted utilities. The national forestry plan indicates the management norms: the province level determines the necessities of forest management, and the district level as well as the forest management unit area (FMU)[15] must follow them. Coordination between the various levels of government, i.e. the MoF, the Governors and the Chief of Regencies and Cities *(Bupati/Walikota)* is also stipulated. The objective for the coordination is to deliver a manual for forest arrangement activities, to develop procedures and work instructions, including officer training, directions, supervision in developing plans, programs and activities, monitoring, evaluation and further actions. However, this Government Regulation does not mention or refer to 'ecoregion' as the unit level of inventory to formulate forestry programs like IBSAB does (see 4.3).

To maintain the watersheds and to optimize the environmental, social and economic benefits for the local community, the Indonesia Government developed a Forest Land and

[15] The applied criteria for FMU establishment are land characteristics, forest types, forest functions, conditions of watershed, socio-culture, economy, local community institutions, including customary laws and administrative boundaries. The FMU is being the target activities, namely: Conservation Forest Management Unit, Protective Forest Management Unit and Production Forest Management Unit (article 2). Their management codes follow MoF Decree No. 464/1995 and No. 140/1998 and MoF Decree No. 252/1993 respectively. In addition, the Ecosystem Restoration for Production Forest Management Unit in Natural Forests is stipulated in MoF Decree No. 159/2004.

Rehabilitation/FLR Program for five years (2003-2007). The Ministry of Forestry/MoF has delegated the Watershed Management Agency (*BPDAS*) for monitoring and evaluation purposes. As mentioned above, each catchment area and or island should retain 30% of the total area as forest area (Law No. 41/1999), this differs from what the lower level Government Regulation No. 44/2004 on Forestry Planning stipulates, namely that the 30% forest cover refers to juridical boundaries (provincial or district) rather than geophysical boundaries. However, multi-functionality of forests can be upheld in all types of forests (except Nature Reserve forests and core-zones of National Parks) with the pre-condition that the applied land use will not change the (main) function. In addition, based on MoF Decree No. 159/2004, watershed programs shall also be considered the 'ecosystem context', including the production of forests.

Additionally, the Forest Land Rehabilitation (FLR) program should be introduced for almost all forest type areas, particularly in critical and non-productive lands (except Nature Reserve Forests and core-zones of National Parks). The purpose was to maintain the carrying capacity, productivity and functions of forests through reforestation, re-greening, tending, enrichment planting and/or application of soil conservation by vegetative and/or mechanical means. All efforts should be made based on the prevailing biophysical conditions. In practice, the program had been directed to 'critical lands' where the expected function of the land has been degraded or lost (DG of Watershed Management and Social Forestry Decree No. 41/1998). A 'critical land' is understood to relate to water-soil problems i.e. hydrology and sedimentation. Thus, it is clear that the substantial direction from the relevant Government Regulation to DG decree has been deduced.

Regarding arising conflicts, particularly in designated forest areas, the Forestry Law also stipulates a participatory approach and cooperation between all stakeholders in a framework of community development. Hence, the FLR program includes them, as well as aims concerning protection and conservation. To achieve them, criteria and standards of forestry supervision are stipulated in MoF Decree No. 8206/2002.

Regarding ownership types, forest land is divided into two categories: State-owned forest is defined as forest land that bears no ownership rights. Under this category, '*adat*' forest is recognized in the Law as an area with traditional jurisdiction. In Java, *adat* forest is not found but various types of benefits can be obtained in state forests through license/permit mechanisms, for example Community Forestry *(Hutan Kemasyarakatan)*, Community-based Plantation *(Hutan Tanaman Rakyat)*, or Village Forestry *(Hutan Desa)*. According to the recent mechanism of Government Regulation No. 34/2002, licenses/permits can be given to individuals, cooperations, private companies (*BUMS)*, regional companies *(BUMD)* or state companies *(BUMN)* (Santosa and Silalahi 2011; Kemitraan 2011). In Java, all state-forests

are entrusted to *Perhutani* (a state forest company), except Nature Reserve forests, National Parks and Nature Recreation Parks.

In contrast to state-owned forest, 'Right-owned forest' or 'right forest' is land that bears ownership rights. However, the utilization of these forests shall follow the designated forest function. Conservation or protection function can be ensured through compensation or incentives for the right holder. This stipulation conforms to the Basic Law No. 5/1960 on agricultural land which assigns that a land holder has obligations to conserve and protect not only the land itself but also the air and water quality.

To summarize, the regulations concerning forestry have highlighted principles of EsA regarding:

Adaptive management issues:

- principle 2: decentralized planning to appropriate Forest Management Unit level (but so far, the forestry sector does not refer to at bioregion or ecoregion unit level); deconcentrated nature conservation and watershed management.

Area and ecosystem structure, functions and integrity issues:

- principle 5: ensuring forest development through optimizing the different forest functions; environmental sustainability (including urban forest).

Stakeholders and economic issues:

- principle 11: forest inventory at all levels (but not at bioregion or ecoregion unit level) to obtain data and information about the resources, natural richness and their environment in a comprehensive way as a basis for area allocation;
- principle 12: participation approach and coordination of all stakeholder in community development e.g. FLR;
- principle 4: align incentive or compensation for right forest holders.

4.3.2. Spatial Planning

The current regulations of spatial planning (Law No. 26 of 2007 and Government Regulation No. 26/2008) follow some basic considerations, including: physical condition, vulnerability to disasters, natural conditions, artificial conditions, human resources, socio-economy, culture and science technology.

The Law stipulates that spatial planning shall be performed in a comprehensive, synchronized, sustainable and integrative way. Spatial planning is classified based on area

systems, main sphere's functions (protective and cultivation function), administrative boundaries/responsibilities and goals for national, province, and regencies/cities level. It aims at supporting top-down policies, designing long term developmental goals for the respective area plans and preventing any negative social, economic and/or environmental impact which might occur due to inappropriate designation within the area and or in adjacent areas. Thus, the spatial plans shall consider areas, functions and activities.

More precisely, the Spatial Planning Law set up two strategies:

- The first strategy is to maintain environmental functions through: determine the protected areas (called 'conservation areas' by the Forestry Law No. 41/1999), and restoring and improving protective spheres, where they have been degraded, with the aim of attaining ecosystem balance of the respective area.
- The second strategy is to prevent negative environmental impacts from human activities through: integrative management, improving the environmental carrying capacity for human activities and pollutants absorbance, preventing negative changes of the natural environment, controlling natural resources use, and improving cultivation methods in disaster areas.

Regarding ecological functions, one of the important provisions of the current Spatial Planning Law is: a minimum area of 30% of each watershed shall be preserved as protection and cultivation (function) sphere. In addition, the law also stipulates the allocation of green space areas /GSA in the cities, namely: a 30% of the total city area shall be allocated for green space area and two third of them (a 20% of the total city area) should be public area. The distribution of green space areas follows the community distribution.

The Spatial Planning Law provides incentive/disincentive mechanisms for right-owned/private lands regarding to their suitability function with land use planning. The spatial plan for rural areas is directed to empower the villagers to preserve local environmental quality as well as support areas, to ensure natural resource conservation, to preserve local culture, and permanent agriculture lands, as well as to compensate rural and urban development impacts.

The space allocation to maintain essential functions compare to the classification in forestry are given in Table 4.6 at the end of this chapter.

Concerning to EsA principles, the Spatial Planning regulations emphasize:

Adaptive management issues:

- principle 3: management strategy to prevent negative impacts, prevention any negative social, economic and/or environmental impacts due to inappropriate designation within area and adjacent areas.
- principle 7: spatial-based system;

Area and ecosystem structure, functions and integrity issues:

- principle 5: aim to improve protection, cultivation, and national strategic area, strategy to maintain environmental functions; and space allocation to maintain the functions.

Stakeholders and economic issues:

- principle 11: all information as basic considerations for spatial planning;
- principle 4: incentive/disincentive mechanisms e.g. compensation from impact of development in rural and urban area.
- principle 12: empower villagers.

4.3.3. Environmental Management

The replacement of Law No. 4/1982 by Law No. 23/1997 on Management of the Living Environment was expected to adapt the economic growth and the increase of global initiatives, and at the same time to strengthen the local/regional capacities. In the further development of environmental management legislation, Law No. 23/1997 has been replaced by Law No. 32/2009 on Environmental Protection and Management. Its purpose is to create environmentally sustainable development through means of the environmental planning policy, and the rational exploitation, development, maintenance, restoration, supervision and control of the natural environment. To aim at this, the Law on Environmental Protection and Management requires the following phases for planning: (1) environmental inventory to obtain data and information on natural resources; (2) stipulation at ecoregions; and (3) formulation of environmental protection and management plans.

(1) The stipulation of ecoregions is purposed to consider the homogeneity of landform characteristics, watershed, climate, flora and fauna, socio-culture, economy, institutions in a community and environmental conditions feature. Those aspects are purposed to determine the carrying capacity of an area and its natural resources.

(2) The formulation of environmental protection and management plans shall be developed at national, provincial and district level, whereas the ecoregion characteristics shall become fundaments of those plans.

(3) To prevent environmental damage, the national and local governments shall develop 'Strategic Environmental Assessments' (Kajian Lingkungan Hidup Strategis) to be integrated into a spatial plan. Inter alia, this encompasses: quality standards for the environment, regulate legal actions and legal relations between persons and/or other legal subjects, control activities which have social impact, develop a funding system for efforts to preserve environmental functions. Every business and/or activity having substantial impact on the environment is subject to an environmental impact analysis in order to obtain a license to conduct such business or activity. Particular attention should be paid to the role that communities should play in environmental protection and management, following the law.

In contrast to the previous law, the current law clearly includes economic instruments, for instance requirements to implement economic planning and activities for development, environmental funds for recovery, nature prevention and conservation, and incentives and/or disincentives like taxes, subsidies, licenses, emission-trade, insurance, labeling etc.

The current law also provides a requirement to develop an environmental information system to support the implementation and development of environmental protection and management policies, rights, obligations and prohibitions of the people. Therefore, community participation is encouraged active participation in environmental protection and management, education and supervision.

Basically, the current law on Environmental Protection and Management is considerably adequate to all EsA Principles since the scope of the stipulation includes:

Adaptive management issues:

- principle 1: environment as the objective of management
- principle 3: formulation of environmental plan and management
- principle 7: formulation of environmental plan and management (spatial and temporal)

Area and ecosystem structure, functions and integrity issues:

- principle 5: stipulation of ecoregion

Stakeholders and economic issues:

- principle 11: environmental data and information on natural resources

- principle 12: community participation
- principle 4: stipulation of economic instruments
  (internalization of environmental cost and benefits)

4.3.4. Regional Autonomy

The Law No. 22/1999 on Regional Governance stipulates decentralisation by giving autonomy from the national government in Jakarta to the country's provincial, regency and city governments. The objective of this law is to empower the district level, to increase democratization and to encourage participation of ordinary people in the development process, as well as to increases and awareness concern of the local capacities with respect to environmental problems.

Under this Regional Autonomy Law, all scopes of authorities are delegated to the provincial and districts administrations, except aspects that need to be looked after at the national level like national planning, natural resource management, conservation and national standardization. The provincial administration under a governor has an authority for inter-district relationships including its administration. The districts and municipalities have responsibilities for public work, health, education and culture, agriculture, industry and trade, investments, environmental issues, co-operation and labour. Between provincial administration and districts there is no longer a 'hierarchical relationship' but rather coordination and cooperation. The provincial administration has just a limited responsibility over districts, which rather conforms to supervision. Within the district's authority, decisions cannot be influenced by the provincial administration. In other words, the district has the highest authority and responsibility for the area. In this respect, the Law risks to be insufficient to support environmental management issues. For instance, the provincial administration has no political power to control trans-district processes like issues on flood-erosion-sedimentation from upper-land to lower-land in a watershed or other environmental issues that impact on adjacent districts.

The details of forestry authority delegation to province and to district are stipulated in Government Regulation No. 62/1998: Delegation Forestry to the Local Government.

In general, the authorities at provincial level have to monitor and evaluate activities, or take over the responsibility when the activities are considered to be more efficient if taken at provincial level. At district level, the authority is delegated to the lower operational levels as kind of a community service, and community participation is required.

In the forestry sector, the province has an authority: to manage Grand Forest Parks and to arrange forest boundaries (a step between forest designation and announcement of area appointment). The regencies have the authority to take over greening activities, land

and water protection, sericulture (silk, bees etc.), or managing garden forests, including right forests in protective areas. In addition, regencies shall promote forest extension/supervision, control non-timber products, traditional hunting of non-protected wild animals in hunting parks, and manage community training in forestry.

'Greening' is an activity to recover or increase the conditions of critical lands outside state forests through planting and establishing constructions for soil and water conservation purposes. In addition, forest supervision is promoted to encourage the delivery of information, including technology transfer through non-formal education of farmers and their families as well as other community groups, who live within and outside the forest.

All in all this Regional Autonomy Law is clearly formulated to support decentralization of area management, following:

Adaptive management issues:

- principle 2: organization structure to lower appropriate level (provincial, regencies/cities).

Stakeholders and economic issues:

- principle 12: involve educators, farmers, and local people.

4.4. Comparison of Regulative Instruments for Forest Functions

The designation of forest function areas through specific regulations is one essential instrument to preserve and control forest ecosystems functionality. In this respect it is not only the Forestry Law which has to be considered but also the Spatial Planning Law, and the Species and Habitat Conservation Law. In order to check whether the classification systems and the given (technical) provisions are mutually synchronized, Table 4.6 shows the comparison between function classifications of these provisions, taking the Spatial Planning Law as a reference and indicating whether the respective functions and sub-functions are mentioned in the other laws (+) or are not (-). Nonetheless, the purpose of this comparison is to show the capacity of the Forestry Legislation for forest functions arrangement.

Concerning the conservation categories, the Forestry Law No. 41/1999 classification differs from the enacted Law No. 5/1990 on Conservation of Living Resources and Their Ecosystem insofar that it does not consider 'Biosphere Reserves' nor Ramsar Wetland Sides. According to Wiryono (2010), such kind of inconsistency does not only concern the classification as such, but also indistinctness of criteria, functions and objectives among sub-categories and sub-sub-categories. This leads to confusion not only by laymen, but even by the conservation staff in the field concerning the relevant management goals.

Gaps and inconsistencies become bigger when comparing the Forestry Law No. 41/1999 to Law No. 26/2007 on Spatial Planning: Concerning the protective functions the Forestry Law neglects peat swamp areas, river buffer zones and coastal flood protection (Tsunami).

Furthermore, it does not provide optional functions of forests for the open country, particularly agricultural areas (see 'cultivation sphere'). In fact, it remains limited to existing forest areas. All in all, the Forestry provisions clearly stipulate forest development in more limited spheres than the Spatial Planning Law.

Concerning Sphere Functions, the latter seems to be better synchronized with the Biotic Conservation Law classification than with the Forestry classification. To a large extent, the Biotic Conservation Law also emphasizes the importance of areas outside designated forests or in adjacent areas. Contrastingly, the Forestry Law is more concerned with administrative compliance of forest designation than with controlling ecosystem functionality.

As mentioned above, some important functional spheres are not included in the forestry classification at all. It can be predicted that in the forestry plan, the designation of those important areas (like peat moss, nature reserves for geology reasons, disaster areas, Ramsar Wetland Sites, water retention areas, ground water areas, or buffer areas) will be missing.

But even if some functions are indicated with '+' with respect to the Law on Spatial Planning this does not necessarily mean that they do have equal meanings since criteria and objectives may differ or remain indistinct.

A significant example will be given in study case 2, but concerns dissimilarities between the Forestry Law and the Biotic Conservation Law with respect to the understanding of 'conservation': the Forestry Law refers to 'areas' that have been designated for conservation of fauna, flora and their habitats whilst the Biotic Conservation Law refers to 'functions' or 'activities' to maintain and to increase the natural capacity for both, biotic and abiotic elements. Such dissimilarities between the laws seem to be caused by sector-centric perspectives which neglect other respective laws.

Some questions that raise from this comparison include: (1) Are forestry provisions limited to designated forest areas and what could be the implications in practice, particularly for area outside designation?; (2) What contribution from the forestry sector can be made concerning areas indicated by the Spatial Planning Law but not considered by the Forestry Law?

Any differences between Laws and their planning products did, and will further impair the natural environment, particularly to ecosystem structures and functions. Under these

circumstances, EsA principle 5, 6 and 10, namely to maintain environmental services and functioning as well as to seek appropriate balance between conservation and biological use, will be difficult to implement.

Table 4.6. Comparison of Spatial Planning, Biotic Conservation and Forestry concerning the Classification of Sphere Functions

Spatial Planning (Law No. 26/2007 and GR No. 26/2008)			**Conservation of Living Resources and their Ecosystem (Law No. 5/1990)**	**Forestry (Law No. 41/1999; GR No. 34/2002; and GR No. 28/2011)**	**Theory (Chapter 2) concerning ecological functions**
Function	Sub-function 1	Sub-function 2	Conservation	Forest Functions	Function(s)
Protective Sphere	*Protective to the lower lands*	*protective forest*	+	*protective*	*Species habitat; soil stabilisation*
		peat swamps	+	-	*Species habitat; water regulation*
		water retention	+	+	
	Local protection	*coast buffer area*	+	+	*Species habitat; Soil stabilisation and water regulation*
		river buffer zone	+	-	
		reservoir / lake buffer	+	+	
		green area / urban forest	+	*green area / urban forest*	*Species habitat; object protection*
	Nature Conservation, Nature Preservation, and Cultural Reserve	*nature reserve*	*nature reserve*	*nature reserve*	*species habitat; process*
		game reserve	*game reserve*	*game reserve*	
		Mangrove coastline	+	+	
		national park	*national park*	*national park*	
		grand forest park	*grand forest park*	*grand forest park*	
		recreation park	*recreation park*	*recreation park*	
		Science and cultural reserve	+	+	
	Protection against natural disasters	*Landslide*	-	+	*object-protection*
		Tsunami	-	-	
		Flood	-	+	
	Geological Protection against nature disasters	*Nature Reserve for geological reasons*	-	-	*object-protection; processes*
		Geo. nature disasters	-	-	
		Ground water protection	-	+	
	Others	*Hunting Park*	+	*Hunting Park*	*species habitat & object-protection*
		Biosphere reserve	*Biosphere Reserve*	-	
		Genetic resource	+	+	
		Evacuation of fauna	+	+	
		Mangrove	+	+	
		Ramsar Wetland Sites	+	-	
		Fauna Evacuation	+	+	
Cultivation Sphere	*Forest Production*	*Limited production*	+	*Limited production*	
		Permanent production	+	*Permanent production*	
		Convertible Production Forest	+	*Convertible Production Forest*	
	Tree garden		+	-	
	Agriculture		+	-	
	Fisheries		+	-	
	Mining		+	-	
	Industrial area		+	+	
	Recreation		+	+	
	Settlement		+	*Urban Forest*	
	Other				

Note:
+ = mentioned in the respective law
- = not mentioned in the respective law

5. Case Studies Concerning the Ecological Functions of Forests

The recent policy on Indonesian forestry is committed to ‘an ecosystem approach’ (see Chapter 1.6.1). Thus, this chapter will present case studies to contrast the commitment that has been made, to some practical examples of facts, developments, projects and programmes.

Basins or watersheds are declared as the target units of activity for the Indonesian forest administration, particularly to ensure forest development through optimizing forest functions and to increase the carrying capacity of the watershed (Law No. 41/1999 on Forestry article 3 b, c). In practice, basins have been used as unit approach for Forest and Land Rehabilitation/FLR programmes.

For this purpose and reason, the Bengawan Solo (BS) River Basin in the north-east of Java / Indonesia has been chosen as study area.

The following description is mainly directed to: 1) understand the characteristics of the study area; 2) present the study cases regarding forest functions arrangement and efforts for forest rehabilitation.

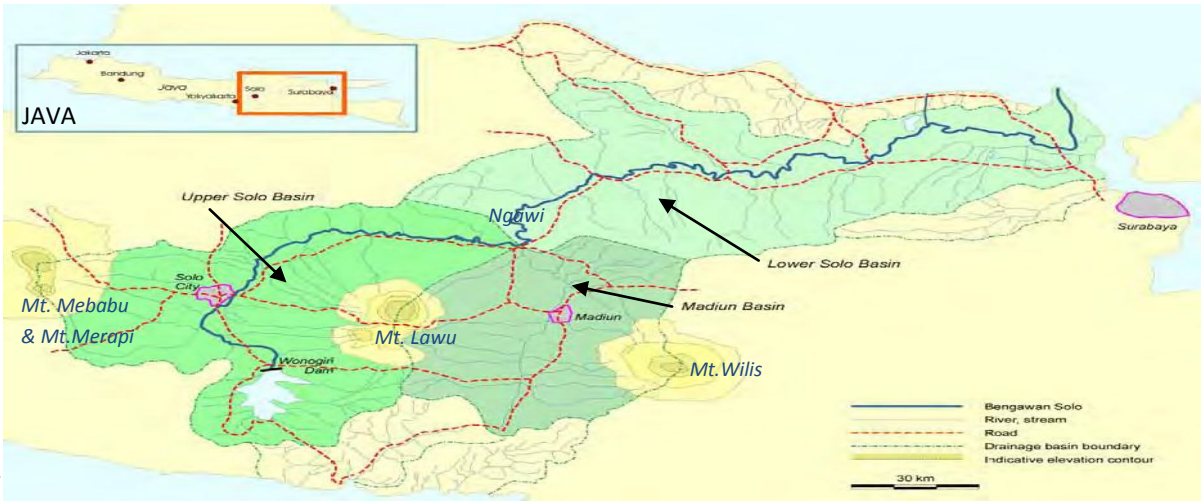
This data and information will then be used to discuss the achievement of the forestry sector relating to the application of EsA principles.

5.1. The Bengawan Solo Basin

5.1.1. Specific Characteristics and Ecosystem Types

The BS River Basin stretches from the Merapi-Merbabu-Lawu mountainous area down to its estuary in the north-east of Java-Indonesia. The original natural environment is tropical rainforest, with ecosystems ranging from the coastal mangrove forest on the north coast, rocky coastal cliff on the southern coast, low lying tropical forest, to the high altitude rainforest on the slopes of the inland mountainous region. The Java environment and climate gradually alters from west to east. It changes from wet and humid thick rainforest in the western parts to a dry savannah environment in the east, corresponding to the climate and rainfall in the regions. Beside its natural characteristics, Java is also known as the world’s most densely-populated places on the globe.

Figure 5.1. The Map of the Study Area: The BS Basin



Source: Hidayat et al. (Center for River Basin Organization and Management, Solo, Indonesia 2008).

Note: The BS Basin comprises three sub-basins, namely the Upper Solo River Basin, the Madiun River Basin, and the Lower Solo River Basin (shown in degraded green colours).

The people that formerly inhabited rainforests altered the natural ecosystems and shaped the landscape by creating rice paddies and terraces to support the growing population and created large settlements, since ancient times. The growing human population has put severe pressure on Java's wildlife. Rainforests have almost disappeared and now confined to highland slopes and isolated peninsulas. Many of Java's endemic species are critically endangered and some are already extinct (Whitten *et al.* 1997). It also led to increasing environmental problems. For example, the BS River Basin is categorized as one of the most critical watersheds in Indonesia (DepKimpraswil 2001).

Since Java is one of the most volcanically active islands in the world, volcanoes play a crucial role in its geological and human history. Volcanoes can be catastrophically hazardous for people living there through the flow of hot, dry particulate material or invisible emission of gasses such as carbon-monoxide, hydrogen-sulphide and sulphur-dioxide or mud-flow called *'lahar'*, and through damaging properties. *Lahar* causes siltation in reservoirs and ports thus raises riverbeds and causes floods in low lying areas. In contrast, volcanoes also give largely positive impacts because they create lands through lava flows, ash deposits and mud flows. In this sense, natural erosion provides benefits by forming new lands through depositing volcanic materials as alluvium plains with a thick layer of fertile sediments (Whitten *et al.* 1997). Based on observation, mud-beds of some rivers are used as paddy-fields during dry season, particularly in Ngawi Regency, as a meeting point from upstream rivers.

Fine volcano ash is transported over great distances from the erupting crater, providing a top dressing of soil-enriching material over a wide area. Therefore these benefits are not limited to the immediate vicinity of the active volcano. Basically, the soil fertility is particularly high in Central and East Java because the volcanoes produce basaltic lavas, and lower in

West Java because the volcanoes produce more silica–rich andesitic lavas (Whitten et.al. 1997 and World Bank 1990). The study Basin has an advantage in terms of nutrient input from the surrounding active volcanoes.

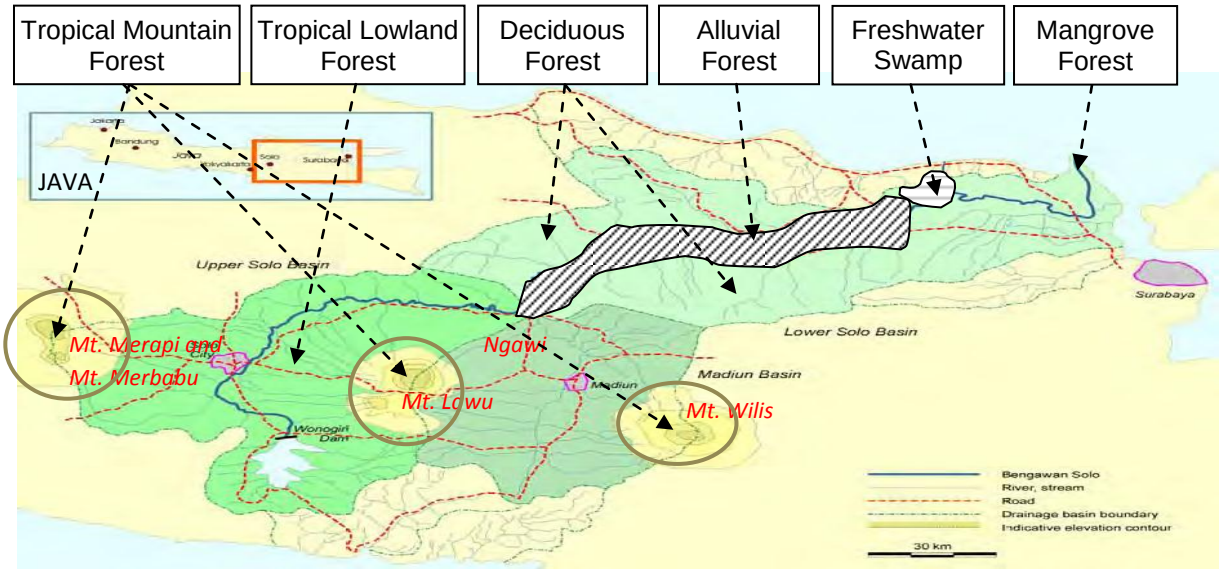
However, volcano activities can also be an agent for major landscape change. Geological disasters like volcanic eruptions and earthquakes as short term hazards cannot be avoided, but certain areas are clearly more at risk than others. Erosion is an example for long–term hazards which ultimately have a greater impact than the more dramatic short term hazards, albeit with fewer deaths. In contrast, erosion is relatively avoidable, particularly erosion relating to land practices by people (Whitten *et al.* 1997).

The BS Basin drains a watershed area of around 1.610.000 ha. It is divided into three sub-basins, namely the Upper Solo River Basin in the west, the Madiun River Basin in the south, and the Lower Solo River Basin in the east (Figure 5.1).

Rivers from these upper streams flow gathering tributaries from steep slopes of volcanic cones of Mt. Merapi (2.914 m a.s.l.), Mt. Merbabu (3.142 m a.s.l.) and Mt. Lawu (3.265 m a.s.l.) meeting in the Ngawi Regency. On the upper land, the soil is volcanic and covered by natural mountain tropical forest. In general, the upstream Basin is characterized by steep slopes (>45%) and about 20% of the total land is very sensitive to soil erosion, about 24% is rather sensitive and the rest is less sensitive. A continuous carriage of a large quantity of eroded volcanic material contributes to a high sediment load in the BS River (DepKimpraswil 2001). According to Erftemeijer and Djuharsa (1988 in Whitten *et al.* 1996), the annual sediment deposited in this river is estimated to be about 11 million m^3. To monitor the level of sedimentation, tapped behind large dams, checks of dams and sluices have been introduced. Meanwhile, the estuary has become very flat. During the dry season tidal influence can be detected 100 km upstream.

The lowland ecosystem from Ngawi Regency starts where the estuary forms an alluvial-plain-ecosystem (DepKimpraswil 2001). For centuries this lowland-ecosystem has been dominated by teak plantations (BPKH IX 2004). The channel of the BS River is prominently low and can have an extensive inundation during floods. Approaching the estuary, vast marshy and swampy areas form the Jero- and Jabung Swamps (DepKimpraswil 2001). The intrusion of sea water to the inland is used for fishponds and salt production (BPKH IX 2004).

Figure 5.2. Natural vegetation Types of the BS Basin



Source: DepKimpraswil (2001) and BPKH IX (2004)

Note: In the BS Basin consists mainly of six natural vegetation types (the locations are indicated with arrows), extending from the mountainous areas (circles) to the estuary (mangrove forest); and climate variation from moist to seasonally dry (deciduous).

5.1.2. Climate

Climate is usually defined as long-term characteristics of weather in a particular place over an extended period of time. Plants and animals are affected directly by the climatic conditions in their environment. A micro-climate is the climate near a particular organism (Gates 1980); or the climate close to the ground (Geiger 1965 in Gates 2003).

The climate of a region consequently has a relationship with the microclimate of each and every habitat within the region. For instance, an aggregate of vegetation of a deciduous forest may appear to respond to the regional climate and impact on its productivity and the ecology of the forest. Therefore, climate has been one of major determining factors in land development, particularly relating to the distribution of vegetation that form flora zones (Whitmore 1984 in Whitten *et al.* 1997; MoE 2009). The combination of forest trees in different parts of BS Basin shows that the vegetation type is determined by the number of dry and wet months, altitude and soil conditions. This can be used to map the original distribution of the natural vegetation types (see Figure 5.2). Based on the number of dry-wet months, BS Basin can be divided into: permanently moist and seasonally dry / deciduous. Based on altitude, BS Basin comprises beach forest, lowland forest, and mountain forest. Based on soil condition, Java has alluvial, mangrove forest and freshwater swamp forest. The BS region has a markedly seasonal climate and the area is part of the driest area of Java (Whitten *et al.* 1997).

Beside the vegetation, disturbances and topography also affect the local climate conditions which for their part influence the ecosystems. For example, the reduction of vegetation cover of the ground surfaces can lead to a hotter and drier climate, as it is well known from urban sites. Land cover changes have altered the albedo, evapotranspiration, sources and sinks of greenhouse gases and other properties which affect the natural system locally, regionally and globally (Klinka 1989). According to Hidayat *et al.* (2008), climate change was the cause of the hardest flooding and landslides in the BS River Basin which happened in late December 2007 and early 2008. He identified a combination of problems including watershed management, deforestation in the region, watershed degradation and the persistence of heavy rains in that period. The lack of flood control structures, incomplete river improvement projects and a lack of drainage systems contributed to the devastating mudslides. Economic loss and damages to roads, irrigation facilities, bridges and dams as well as the potential harvest failure were immense.

5.1.3. Soils

Indonesia is located in the equatorial zone, where temperature and humidity are relatively high throughout the year. Rapid decomposition and volcanic ashes on soil are weathered rapidly and provide free application of useful minerals. In some areas where dry periods are missing in favour of a high frequency of rainfall, tropical soils are subject to extreme chemical weathering and leaching which makes them acidic and nutrient poor. This is the case in the highland of the western part of Java. Soluble minerals gradually leach away in mature soils and produce acid, kaolinitic, aluminium-rich clays which are unable to hold soluble minerals. Soil fertility can be maintained by the presence of humus and litter on the soil surface (Whitten *et al.* 1997).

In areas with a high frequency of rainfall, landslides occur frequently. They are one of the most dangerous consequences of earthquakes, especially in areas with high erosion risk, where inappropriate land uses occur. Sinukaban *et al.* (1991) and Whitten *et al.* (1997) asserted further that land use determines the pace of erosion. Progressive deforestation followed by regular soil tillage and removal of other protective vegetative cover will expose soil more to erosion. Serious cases have occurred for instance with the increasing number of areas under annual cropping systems where tillage soil is left exposed during critical periods like at the beginning of the wet season. Such conditions can be found in parts of the mountainous areas of the Basin, like Mt. Merbabu, Mt. Merapi and Mt. Lawu.

In areas with a seasonally dry climate, like in the north-eastern part of Java, evaporation forces dissolved minerals through the soil to the surface by capillary action, where they eventually crystallize out of solution. However, loss of nutrients is less than in the humid zones. In the seasonally dry zones, calcareous rocks in fertile clays form mature soils,

but unfortunately they swell, become impervious, intractable, and sticky when the rain comes, while they tend to shrink, crack, and become very hard during the dry periods.

Alluvial soils develop more or less independently from the climate because they occur when the water table is always high (Whitten *et al.* 1997). In general, potential natural erosion of any soil in Indonesia is much higher than in temperate areas due to the high frequency of rainfall, and the erosion risk in volcanic soil which is much higher than in limestone soils (World Bank 1990; Whitten *et al.* 1997).

Table 5.1 shows data from a survey taken of the soil groups in the BS Basin in 1974 and corresponding land use forms, including the locations where those combinations are predominantly found.

Table 5.1. Soil Group and Land uses on the BS Basin

Great Soil Group	Land use	Location
Alluvial soil	Paddy field	Valley of Upper Solo and Madiun River (volcanic origin); Lower Solo (non-volcanic origin)
Regosol	Paddy field	Mt. Merapi and Mt. Lawu (sloping)
Lithosol	Upland field, or forest	Hilly areas and mountain slope areas
Andosol		
Mediterranean		
Latosol	Farmland or forest	Great part of areas skirting Mt. Lawu and Mt. Wilis
Grumosol	Paddy, sugar cane, and other agric. crops	Found between alluvial soil in upper basins and in hilly areas in lower basin.
Complex		

Source: OTCA Japan, Survey and Study for the Development of BS Basin (1974 in DepKimpraswil 2001).

5.1.4. Land Systems and Physiographic Regions

MoF Decree No. 20/2001 on Model, Standard and Criteria for Forest and Land Rehabilitation/FLR states that FLR planning shall be based on the land system rather than on a single component like the soil type. However soil groups, as shown above, may be important to consider land use practices, their suitability for agriculture and their inherent effects.

A land system is a combination of rock type, hydro-climatology, landform, soil and organisms and the interrelations between them. It is not unique to one locality but recurs wherever the particular combination of characteristics is found. Land systems that have this similarity can be grouped into different physiographic types like mountains, hills, alluvial plains, alluvial fans and lahars, plains (non alluvial), alluvial valley, tidal swamps, terraces and beaches. A grouping of lands among which certain land systems may be shared is called a physiographic region (Whitten et.al 1997). These regions expose natural vegetation

types and appropriate human activities, and are usually considered as the basis for land management for sustainable development (DepKimpraswil 2001).

On Java, 128 land systems have been recognized. Those can be divided into four major physiographic regions, namely: Northern Alluvial Plains, Northern Foothills and Plains, Central Volcanic Mountains, and Southern Dissected Plateaux and Plains. The BS basin covers the Solo alluvial plain sub-region (Northern Alluvial Plains region) and the Merapi and Lawu volcanic complex sub-regions (Central Volcanic Mountains region) (RePPProt 1990 in Whitten *et al.* 1997).

5.1.5. Ecoregions

An ecoregion is an ecosystem of regional extent (Dinerstein et.al 1995 in Wikramanayake *et al.* 2002) and specific regional diversity (Kozlowski and Peterson 2005). The delineation of ecoregions is based on bio-geographic zones, elevation such as lowland or mountain, and vegetation pattern as a proxy for the climatic gradient where appropriate, such as wet and dry forests. This kind of delineation is basically based on the regional distribution of biomes (Wikramanayake *et al.* 2002).

According to MacKinnon (1986 and 1997 in Wikramanayake *et al.* 2002) ecoregions are suitable as a basis for inventarization and environmental planning at regional and global scale because they:

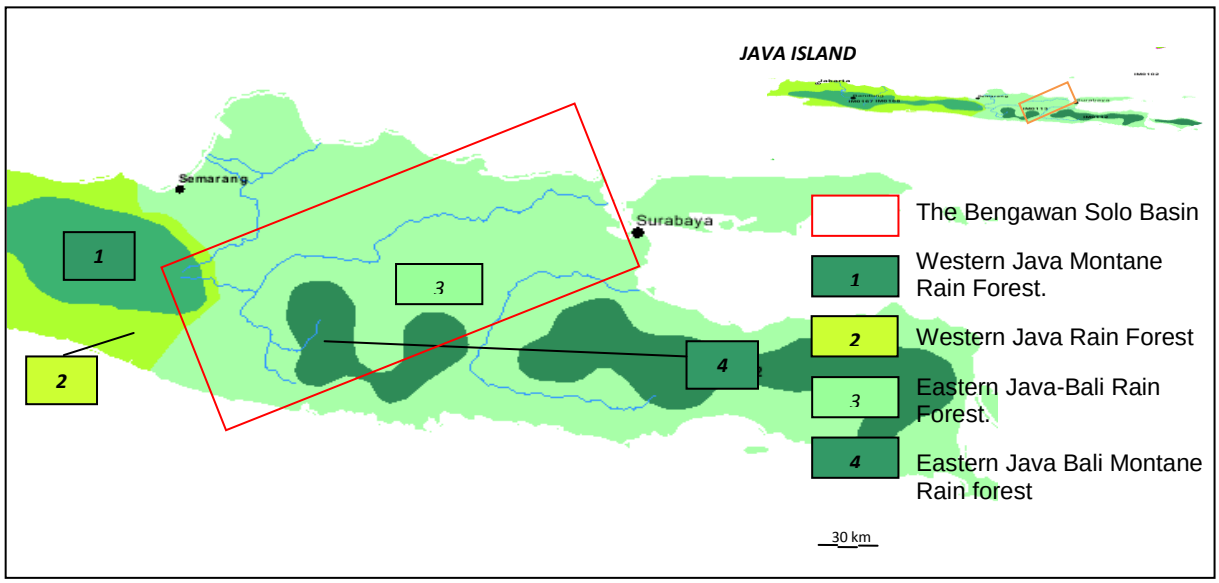
- represent a range of habitat types and ecological processes rather than a single taxonomic unit
- correspond to the major ecological and evolutionary processes that create and maintain biodiversity
- better address the conservation needs of populations, especially for species that need large habitat areas
- enable conservationists to determine the best places to invest scarce resources to protect a representative sample of the region’s biodiversity
- represent the dynamic area within which restoration efforts should be undertaken.

However, the Indonesian forestry sector does not consider ecoregions for forest planning and for the designation of conservation areas so far (BPKH IX, 2004 pers.com). Since the Law No. 32/2009 on Environmental Protection and Management initiated that ecoregions shall be the basis for inventarization and development planning at national, regional and local government level, respective integration into forestry planning is required.

Otherwise the different approaches may result in spatial planning discrepancies, where FLR program based basin delimination and sub-divisioning overlays with differing ecoregion

demarcation, representing biodiversity statements concerning the respective areas. It requires to first understanding the current ecological conditions expressed by land cover or land use and forest management and then link them to natural richness and habitats.

Figure 5.3. Ecoregions on the BS Basin



Source: Wikramanayake et al. 2002

The BS Basin overlaps four ecoregions. The following paragraphs describe the biome characteristic of each ecoregion, including the existing conservation areas in the Basin (Figure 5.3 and Table 5.2):

- The Western Java Montane Rain Forest (1) represents montane forests of west Java with 2-3 dry months. The designated areas in this ecoregion that overlap with the study Basin are the National Parks Mt. Merapi and Mt. Merbabu, which cover 6410 ha and 5725 ha respectively. Both are not proposed as protected areas by WCMC (Whitten *et al.* 1997).
- The Western Java Rain Forest (2) represents lowland moist forests of western Java covering only a small part of the study Basin.
- The Eastern Java Bali Rain (3) forest represents the lowland moist forests of eastern Java. Almost all natural habitats have been cleared and converted to farms, settlements and plantations for a long time. The common plantation stand is *Tectona grandis*, which has been cultivated for centuries. Only a small part of the original forest that overlaps with the study Basin has been preserved, namely the Nature Reserve (*Cagar Alam*) Bekutuk. It covers an area of just 25,4 ha (0,254 km^2) while 20 km^2 have been proposed for a conservation assessment and categorized as protected areas category I: Strict Nature Reserve or Wilderness Area by IUCN (Whitten *et al.* 1997).

- The Eastern Java Bali Montane Rain Forest (4) represents the montane forests of eastern Java and Bali that has 4-6 dry months. In the Basin, two small Nature Reserves (*Cagar Alam*), namely Mt. Picis covering 27,9 ha (0,279 km^2) and Mt. Sigogor covering 190,5 ha (1,905 km^2) are located in Mt. Liman-Wilis while the Grand Forest Park (*Taman Hutan Raya*) Ngargoyoso covers 231,3 ha (2,313 km^2) and is located in Mt. Lawu. In contrast, the size of the area which should be protected according to WCMC (1997 in Wikramanayake *et al.* 2002) is 2.000 ha (=20 km2), 23.000 ha (=230 km2) and 29.000 ha (290 km2) respectively. Further Mt. Picis should also be categorized as protected area with a category I, with a minimum size of another 20 km^2.

Table 5.2. Overlap of Conservation Areas with Ecoregions in the BS Basin

No	Conservation Area (MoF Decree)	Location	Area (km2)	WCMC 1997 [2] Proposal (km2), [IUCN Category]	Forest Ecosystem Type [1]	Ecoregion
1	Nature Reserve Bekutuk (No. 596/1979)	Blora	0,254	20 [I =Strict Nature Reserve / Wilderness Area]	Dry - lowland forest	Eastern Java Bali Rain Forest
2	-	-	-		-	Western Java Rain Forest
3	National Park Mt. Merapi (No. 134/2004)	Sleman, Magelang, Klaten, Boyolali	64,1	-	Tropical forest vulcan.	Western Java Montane Rain Forests
	National Park Mt. Merbabu (No. 135/2004)	Magelang, Semarang, Boyolali	57,5	-	Mountainous tropical forest	
4	Grand Forest Park Ngargoyoso (No. 849/1999)	Karanganyar (Central Java)	2,313	290 [?]	No information	Eastern Java Bali Montane Rain Forest
5	Nature Reserve Mt. Picis (GB No.36 Stbl No. 43 of 1924)	Ponorogo (East Java)	0,279	20 [I=Strict Nature Reserve / Wilderness Area]	Mountainous Rain-forest	
6	Nature Reserve Mt. Sigogor (GB No. 23 Stbl. No.471 of 1936)	Ponorogo (East Java)	1,905	230 [?]	Mountainous Rain-forest	

1) refers to the respective Decrees
2) in Wikramanayake et al. 2002

5.1.6. Land Cover and Land Use

Almost all of the natural forest habitats of Java have been cleared long time ago for agriculture and settlements providing for the rapidly expanding human population. Only tiny fragments of disturbed semi-natural forests remain (Wikramanayake *et al.* 2002; see also Figure 5.4).

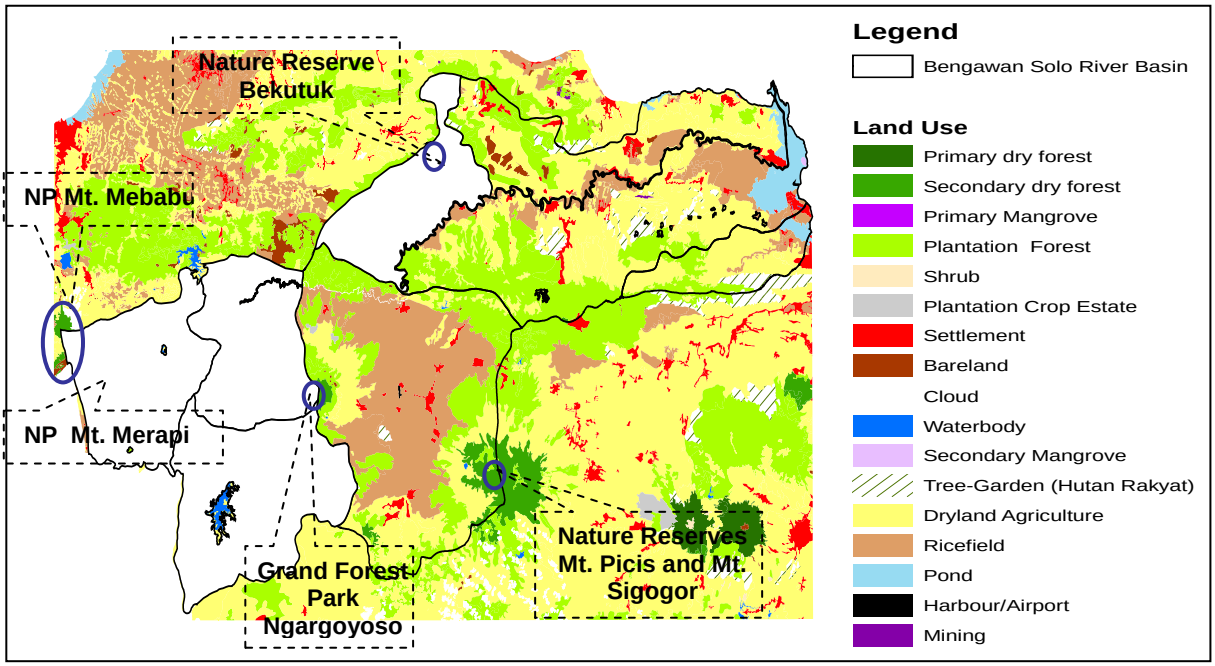
Table 5.3 shows the land use change data in (ha) from early 1970's to 1998 in the BS Basin. The data illustrate that the total wet paddy cultivation and dry land agriculture have decreased while the total of other land uses such as for settlement and non-productive uses have increased. On the other hand forestland use has increased slightly, particularly in the upper Solo Basin. It has been claimed for forest rehabilitation programmes, which were started in 1979. The rehabilitation effort was initiated after severe floods had hit Bengawan Solo in 1966. It started on a small comprehensive 200 ha project in 1972 – 1978 (BPTKPDAS 2011).

Table 5.3. Land Use Change (in ha and % from total Basin) in 1970 to 1998 on the BS Basin

Year 1970	Non-Forest								Forest		Total
	Wet Paddy		Dry-land		Others		Total				
	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha
Upper Solo	227.400	14,1	135.300	8,4	182.600	11,3	545.300	33,8	61.900	3,8	607.200
Madiun	138.800	8,6	43.300	2,6	96.200	5,9	278.300	17,2	97.200	6,0	375.500
Lower Solo	199.000	12,3	133.200	8,5	98.500	6,1	430.700	26,7	196.600	12,2	627.300
Total	**565.200**	**35,0**	**311.800**	**19,5**	**377.300**	**23,3**	**1.254.300**	**77,7**	**355.700**	**22,0**	**1.610.000**
Year 1998											
Upper Solo	201.700	12,5	130.000	8,0	194.500	12,0	526.200	32,6	81.000	5,0	607.200
Madiun	132.300	8,2	57.200	3,5	89.000	5,5	278.500	17,3	97.000	6,0	375.500
Lower Solo	221.300	13,7	92.700	5,7	102.500	6,3	416.500	25,8	210.800	13,0	627.300
Total	**555.300**	**34,4**	**279.900**	**17,2**	**386.000**	**23,8**	**1.221.200**	**75,7**	**388.800**	**24,0**	**1.610.000**

Source: DepKimpraswil 2001

Figure 5.4. Land Use Types and Locations of Designated Conservation Areas in the BS Basin



Source: BPKH IX (2004)

Note: This map indicates only locations of the designated conservation areas and type of land uses in the BS Basin. Scale does not show the actual size.

5.1.6.1. Agriculture

Java is dominated by agriculture land used as rice wetland and dry land fields. The total of agriculture land uses covered about 54,4% of the Study area in 1970 and has decreased to 52,8% in 1998. However, as reported by the CDMP study (DepKimpraswil 2001), not all soil types are appropriate for agriculture purposes. Investigations made in 1998 revealed that about 43% of total wetland-paddy was not suitable for paddy field utilities, about 14% was marginally suitable and about 13% was conditionally suitable due to limitations like inundations, poor soils and steep slopes.

Dry-land field agriculture does not require an irrigation system. In the study area, it is found in wavy, hilly or mountainous topography. Dry-land field agriculture is determined also for other areas unreached by irrigation systems, or for wetland areas that are used for 'polowijo' (subsidiary food crops like soy bean and mungo bean) in turn with paddies during dry seasons. Other examples of *polowijo* are maize, cassava and groundnuts which are planted on dry-land under moist conditions. This practice has been extended on the upland slopes. Various perennial crops are also found, such as coconut, kapok, cacao, coffee, cloves etc. and fruits trees such as durian, mango, rambutan, banana etc. Some fields are planted with vegetables e.g. potatoes, carrots, long beans, shallots, cabbage, tomatoes, chilli etc. These vegetables are mostly found under conditions of cool climate and deep soil with good drainage, preferably on the slopes of Mt. Merapi, Mt. Merbabu and Mt. Lawu (DepKimpraswil 2001).

There are various types of dry-land agriculture used in Java, representing different combinations and dominations of crops or trees, namely:

- if a farm is dominated by various perennial trees, it forms a mixed-garden ('*kebun*' or '*tegalan*');
- plants around a house with some perennial crops that are usually for home consumption and supplementary income, form a home-garden ('*pekarangan*');
- if an area is dominated by 'forest' trees, it forms a tree-garden ('*hutan rakyat*'). *Hutan rakyat* under the MoF Decree No. 49/1997 is determined as an area with a minimum size of 0,25 ha and 50% coverage by trees, or at least 500 stems/ha.

In human-dominated areas where natural forests have been cleared, these different types of land coverage may be ecologically relevant. It might not necessarily increase the biodiversity, but it should increase the environmental benefits.

From the vertical structure, home gardens in Java are arranged in 5 vertical strata. The layered structure of home gardens is not static due to replacement plants that are continuously taking the place of older components that have been removed. The lowest stratum (under 1 meter) consists of spices, vegetables, sweet potato, *taro*, *Capsicum sp* (chilli), eggplant etc. The 1-2 m layer has food plants such as cassava. The middle layer (2-5 m) has fruit trees such as *Musa paradisiaca* (banana) and *Carica papaya* (papaya). The 5-10 m layer has larger fruit trees such as jackfruit, guava, and *Syzigium aromaticum* (clove). And the tallest layer (>10 m) contains of *Cocos nucifera* (coconut), *Mangifera indica* (mango) and *Parkia speciosa* (*pete*). Other common tree species include *Leucaena leucocephala* (*lamtoro*) and *Paraserienthes falcataria* (*sengon*) (McDicken 1990).

From a diversity point of view, home gardens represent an important repository of genetic diversity. For example, in the Citarum watershed /west Java, 34 varieties of banana (*Musa sp.*) were found (Abdoellah 1977 cited in Christanty 1990). According to Jensen (1993a), the Javanese home garden resembles the young secondary forest in structure and biomass and may be considered as a man-made forest kept in a permanent early succession state that assures a constantly high growth rate. In contrast to other agricultural systems, home gardens preserve and improve the ecological conditions essentially towards the long term sustainability of the system. They also favour biological activities, such as dispersal, pollination, natural regeneration, beneficial growth, reproduction and regeneration of crops and wild species and they optimise the use of light (Nair 1989).

Home gardens in Java contributed about 1,398 million ha to land use in 1933 (equal to 10,5% of Java), and 1,554 million ha in 1980 (equal to 11,6% of Java) (Soemarwoto 1987).

Tree gardens in Java are also usually planted in a multi-layer structure, but they are dominated by selected tree species, such as, bamboo and other fast growing trees like *Paraserienthes falcataria* (*sengon*), *Swietenia macrophylla* (*mahoni*), *Toona sureni* (*suren*), *Melia azidarach* (*mindi*), coconut etc. Tree gardens also consist of fruit trees like banana, papaya, *pete*, clove etc. The common species that are planted as under-storey are chilli, vanilla, turmeric, galingale, ginger etc. The variety and utility of species in tree gardens are usually selected locally and as an alternative to social forest development (Soemarwoto 1987).

From the aspect of vegetation structure, agricultural dry-land like home gardens and tree gardens are more likely to give protection to the soil surface than forests in Java do, since those are usually managed mono-culturally with even-storey form. According to Nair (1989), there were no observable signs of erosion in home gardens on sloping land. The litter layer plays a more important role in protecting the soil from erosion than the leafy canopy does because a canopy of more than 8m in height does not reduce the erosive energy of

raindrops which reach high velocity. According to Soemarwoto (1987), a lower canopy at 3m height with narrow drip-tips does have a protective effect against splash erosion. Therefore litter plays an important role to reduce surface erosion and at the same time increases water infiltration into the soil. Erosion from home-gardens is approximately in the range of 0,01 – 0,14 ton/ha/year, with a median of 0,06 ton/ha/yr (Nair 1989). According to Soemarwoto (1987), home-garden agro-forestry has ecological functions almost like a forest: It provides hydrological and microclimate benefits, soil erosion control, genetic resource conservation and socio-economic benefits for people.

5.1.6.2. Forestry

The Indonesia Ministry of Forestry classifies (forest)-land based on ownership type, and it will indicate the type of management intervention and coordination for the land development. Based on ownership, forestland is classified into 'state forest' owned by the state and expressed as 'designated forestland' ('*didalam kawasan*'); and '*right forest*' as '*non-designated forestland*' owned privately ('*diluar kawasan*'). Forestlands under designation are appointed for: conservation, protection or production purposes.

Table 5.4 shows a comparison of land cover and possession (in %) between Indonesia-Java- and the study area.

Table 5.4. Comparison Forest and Non-Forestland based on Ownership between Indonesia, Java and BS Basin scale

Scale	Total Terrestrial Area (ha)	Land cover	Total Area (ha)	Designated -State owned- (%)	Non-Designated -Private owned- (%)
Indonesia	187.786.000	Forest	90.907.000	48	4
		Unforested	74.394.000	19	22
Java	13.371.395	Forest	2.360.035	14	4
		Unforested	10.587.052	9	70
BS Basin (1999-2000)	1.610.000	Forest	643.197	17	7
		Unforested	1.339.708	7	70

Source: Statistic Data 2002 (Bureau of Information MoF 2002), and BPKH IX [16] (2004)

The table above shows that 77% of the total BS Basin is privately-owned land, almost same like in entire Java (74%), but distinctly differing from standard conditions in Indonesia where only 26% of the land are privately owned. The private forest land covers about 7% of

[16] BPKH is a unit management for forest planning at (group of) island level. The working area of BPKH IX is Java and Madura islands (MoF Decree No.6188/2002). So far, the BPKH IX has functions including to carry-out assessment of forest based functions (using an extent technology such as GPS and GIS) and integrating forest data and information from various forestry offices in the working area i.e. Perum Perhutani, Watersheds Management Agency offices (BPDAS), National Parks, and Provincial- and District- Forestry Services.

the total Basin area, 4% of total Java and also 4% of total Indonesia. According to MoF Decree No. 49/1997, private-owned forests are limited to tree gardens / *'hutan rakyat'.* Tree garden has an area of at least 0,25 ha, the crop canopy closure of wood and / other plant species more than 50%, and/or in the first year this area has at least 500 plants per hectare.

State-owned land in the BS Basin (24%) and in Java (23%) is used in another way compared to Indonesia (67%). At the national scale, state-owned forest land adds up to 48%, while in Java it does only cover 14% and in the BS Basin 17% of the area.

According to the Law No. 26/2007 and Government Regulation No. 26/2008 on Spatial Planning, at least 30% of an island and of a watershed should be forested and protected to maintain ecological functions. However, neither Java (28%) nor the BS Basin (24%) does reach this recommended level.

The two tables below (Table 5.5 and Table 5.6) give a comparison of forests functions arrangement in Indonesia, Java and the BS Basin in ha and in %.

Table 5.5. The composition of the Designated Functions of Forests in Indonesia, Java and the BS Basin (in ha)

Level	Designated Forest (State-owned)					Non-Designated (Private-owned)	Total
	Conser-vation (NR-NP)	Protection	Production				
1	2	3	4	5	6	7	8
INDONESIA (a)						x 1000	x 1000
Forested	12.858	20.903	20.510	17.769	10.882	7.985	90.907
Unforested	2.835	4.798	10.964	4.702	9.629	41.466	74.394
No Data	3.678	4.359	3.859	3.159	2.224	5.206	22.485
TOTAL	**19.371**	**30.060**	**35.333**	**25.630**	**22.735**	**54.657**	**187.786**
JAVA (b)						x 1000	x 1000
Forested	353	464	877	177	0	488	2.360
Unforested	55	198	772	170	0	9.392	10.587
No Data	20	10	16	14	0	364	424
Total	**428**	**672**	**1.665**	**361**	**0**	**10.244**	**13.371**
BENGAWAN SOLO RIVER BASIN 1999-2000 (c)							
Forested	196	26.962	241.641	1.435	0	102.729	372.963
Unforested	142	5.283	99.084	2.999	0	1.124.692	1.232.200
No Data	0	7	440	0	0	4.390	4.837
Total	**338**	**32.252**	**341.165**	**4.434**	**0**	**1.231.811**	**1.610.000**
BENGAWAN SOLO RIVER BASIN 2003-2004 *(d)*							
Forested	123	27.778	273.711	1.679	0	112.167	415.458
Unforested	214	4.470	67.455	2.755	0	1.119.196	1.194.090
No Data	0	4	0	0	0	448	452
Total	**337**	**32.252**	**341.166**	**4.434**	**0**	**1.231.811**	**1.610.000**

Source:
a and b: Landsat Image Interpretation (Departemen Kehutanan 2002)
c and d: Landsat Image Interpretation (BPKH IX 2004).

Table 5.6. Comparison of State-owned Area-based Functions (%) between Indonesia, Java and the BS Basin (in %)

Land cover	State-owned (%)																				Private-owned (%)			
	Conser-vation (NR+NP)				Protective				Production															
									Limited				Permanent				Convertible							
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
Forested	7	3	0	0	11	3	2	2	9	1	0	0	11	7	15	17	6	-	-	-	4	4	6	7
Unforested	2	0	0	0	3	1	0	0	3	1	0	0	6	6	6	4	5	-	-	-	22	70	71	70
No data	2	0	0	0	2	0	0	0	2	0	0	0	2	0	0	0	1	-	-	-	3	3	0	0
Total	**11**	**3**	**0**	**0**	**16**	**4**	**2**	**2**	**14**	**2**	**0**	**0**	**19**	**13**	**21**	**21**	**12**	**-**	**-**	**-**	**29**	**77**	**77**	**77**

Own Presentation, based on Table 5.5.

Note: a = Indonesia; b = Java; c = BS Basin (data 1999-2000); d= BS (data 2003-2004).

The forestry planning determines state-owned areas for various purposes. As seen in Table 5.6, the production function clearly occupies the biggest proportion of the designated area, namely 45% of Indonesia, 15% of Java and 21% of the Basin. The proportion for protection functions is about 16%, 4% and 2% respectively; while for the conservation function it is 11%, 3% and far below 1% respectively of each total area. Concerning the conservation function in the study area, the data above still not includes the National Parks Mt. Merapi and Mt. Merbabu, which were designated later and protected in year 2004. Based on land-sat interpretation data 1999-2000 (Table 5.5), the forested area under conservation function was just about 196 ha and decreased to 123 ha (data 2003-2004). This means that about 37% of the already tiny conservation area was destroyed within just four years. The cause is unclear.

The management of the conservation area of the Basin is under the authority of the Nature Conservation Agency for the Central-Java province and the East-Java province. While the total area under protection did not change (2%), some efforts under the FLR program have increased the total forested area by about 816 ha.

On Java, convertible production forests have not been allocated and in the study area this function type also covers only tiny areas (<1%). The designated function is mostly for permanent production and covers about 21% of the Basin and 13% of Java. According to land-sat image data from 1999-2000 and 2003-200, production functions in the Basin increased by 2% (15% to 17%) due to afforestation. The Basin has an important value in terms of production forests, which are dominated by teak plantations. The management for this designated production area is under a state company called ‘’Perhutani’’.

In general, the forest management scheme in Java is unique compared to other regions in Indonesia. The small share of remaining forestland is managed by Perhutani and outer Java is managed by forest concession right holders (*Hak Pengusahaan Hutan/HPH*) and industrial forest plantation right (*Hutan Tanaman Industri/HTI*) holders. The monopoly of

forest management in Java by Perhutani has a long history. Forest exploitation began already in 1596 by the Dutch colonial administration. For the next several hundred years, teak forests were harvested for the ship building industry, construction material and local uses without deliberate forest regeneration efforts. Reforestation with plantations only started at the end of the 19th century and the colonial government organized management institutions, management areas, and regulations (Peluso 1992). At the end of the colonial period which was initiated by political upheavals in the mid 20th century, approximately 500.000 ha of the forested land on Java and Madura was severely degraded. During the Japanese occupation (1942-1945), the Dutch colonial law on land ownership remained legally effective. However, in an effort to double agricultural production in order to meet war-time needs, the Japanese authority loaned forest land to residents for dry land rice and non-rice crop farming. Timber exploitation increased to approximately 200 times the previous rate, and the sustained yield plantation system was abandoned during this period (*Departemen Kehutanan* 1983).

Following the independence of the Republic of Indonesia in 1945, the Indonesian government restored the Dutch system of commercial concessions for Java's teak plantations, with some modifications to the land use classification system. In 1963, forest management in Central Java (Unit I) and East Java (Unit II) was transferred to a state forestry corporation (Perusahaan Negara Perhutani), whereby each province was managed by an independent Directorate, and coordinated by a central Advisory Board (Peluso 1992). In 1972 this was replaced by the current state-owned forestry corporation (*Perusahaan Umum Kehutanan Negara/Perum Perhutani*) and plantation management was brought under a single Directorate in Jakarta, with regional management performed at the provincial (Unit) level. Existing forest units were further devided into Forest Management Units (FMDs). In 1977 the production-zone forests of West Java (Unit III) were brought under Perum *Perhutani* management as well (Simon 1993).

The present form of Perhutani is a public management company (*Perum*) with a social mission (Government Regulation No. 15/1972, revised by Government Regulation No. 36/1986 on Perhutani). As a state-owned forestry enterprise under the authority of the Ministry of Forestry, the company's mandate covers three aims, namely: 1) making profits through maximized utilization of forestlands; 2) sustain forest resources and the environment; and 3) increase the welfare of society, especially of those living in and nearby the forest. Twenty percent of the net profits must flow back to rural economic and social development in the areas of operations.

Perhutani manages more than 2 million ha or about 19 % of total terrestrial Java and Madura with 15% being designated for production function and 4% for other functions, like protected forest and special purpose land. The area consists of only small portions of natural

forests and a big portion of plantation forests mostly dominated by teak species (*Tectona grandis*). No area is designated as conservation area, but basically the company recognizes the necessity of protective values e.g. wildlife within their area.

Perhutani's management plans at the Forest Management District/FMD (*Kesatuan Pemangkuan Hutan*/KPH) level are operated in 10 years planning periods (*Rencana Pengaturan Kelestarian Hutan/RPKH*). Based on this RPKH annual work programs are produced. The 10 year management plan is revised after five years to take account of any changes in circumstances by fires or theft. Beyond the ten year plan there is a strategic 20 year-plan at Unit level which gives an overview of how the whole Unit will meet its supply targets in the long term (Perum Perhutani 1998).

Considering the state and small proportion of state forests in the study area, as well as the insufficient size and proportion of the existing designated conservation areas, private-owned land is rather important for nature protection and conservation. In this respect it has to be kept in mind, that the data provided by forestry sector is limited to tree gardens *(hutan rakyat)*, while there are other tree dominated traditional land use practices, like home gardens and mixed gardens which have been recognized and proven to be eco-friendly (see Chapter 5.1.6.1).

Referring to re-classification of protected areas as endorsed by IUCN in 1994, the proposed conservation strategies for the region's biodiversity include a full tapestry of biodiversity features. In this respect a variety of lands might play a role in the conservation of natural resources and values. They should be preserved with the overall goal of being a progression towards sustainable living. Thus over 70% of the total area under private-ownership is crucial to be managed focusing on land values for conservation purposes.

5.1.6.3. Land for 'Other Purposes'

According to the National Spatial Planning, 'land for other purposes' means areas outside agriculture and forestland, consisting of urban areas, rural settlements, shrubs, bare land and water bodies (DepKimpraswil 2001). In the Bengawan Solo Basin, about one quarter (24%) of the total area is used for these 'other' purposes (Table 5.3, data 1998). Half of it is located in the Upper Solo Basin.

Based on Government Regulation No. 63/2002, Urban Forests are declared by the Chief of Regency/City. The minimum size of Urban Forests should be 0.25 ha. Urban Forest designation depends on the number of population, pollution levels, and the physical characteristics of the area. In addition, the Urban Forest should be planned as an integral of spatial planning, and considered as part of the green space area. They can be set up in the

state- or in private owned area. If private-owned forest is declared to be an Urban Forest, the government has an obligation to give compensation / incentive to the forest owner.

5.1.7. Population

The island of Java covers only 6,5% of the total terrestrial area of Indonesia but it has an extremely high population density (about 938 people/km^2) which is nine times higher than the average population density of the country (106 people/km^2 in 1998). This is the result of historical influences and natural conditions, namely the very fertile volcanic soil that is suitable for terracing and rice paddy irrigation. Since Java has a long history of settlement and agriculture compared to other Indonesian islands, the cultural landscape is dominated by agriculture (DepKimpraswil 2001).

The population density in the study area (783 people/km^2) is unevenly distributed due to advanced urbanization and several economically active regencies and cities like Sukoharjo Regency (1.560 people/km^2), Klaten Regency (1.883 people/km^2), and Kota Surakarta (11.955 people/km^2), the Upper Solo Basin has the highest population density (1.037 people/km2). However, it is increasing in all regencies and cities. During the last 20 years, the urban population of the BS Basin increased by 14% (DepKimpraswil 2001).

Table 5.7. Population Number in the BS Basin per Kabupaten in 1998 and 2007

Province	Sub-Basin	Regency/ City	Size of Area (km^2)	1998 [1]		2007 [2]	
				Number of population	Population density (people/km^2)	Number of population	Population density (people/km^2)
Central Java	Upper Solo	Boyolali	1.008,45	866.100	859	983.285	975
		Klaten	658,22	1.234.100	1.875	1.291.971	1.963
		Sukoharjo	489,12	727.800	1.488	828.533	1.694
		Wonogiri	1.793,67	981.900	547	1.124.480	627
		Karanganyar	775,44	750.500	968	842.119	1.086
		Sragen	941,54	849.900	903	892.555	948
		Kt.Surakarta	46,01	526.400	11.441	560.541	12.183
		Total	5.712,45	**5.936.700**	***1039***	**6.523.484**	***1142***
	Lower Solo	Blora	1.804,59	799.400	443	902.223	500
East Java		Bojonegoro	2.198,79	1.170.600	532	1.233.506	561
		Tuban	1.834,15	1.006.800	549	1.123.260	612
		Lamongan	1.782,05	1.189.000	667	1.391.401	781
		Gresik	1.191,25	928.800	780	1.223.447	1.027
		Total	8.810,83	**5.094.600**	**578**	**5.873.837**	***667***
	Madiun	Ponorogo	1.305,70	884.500	677	1.054.300	807
		Madiun	1.037,58	651.000	627	685.504	661
		Kota Madiun	33,92	186.300	5.492	197.553	5.824
		Ngawi	1.295,98	848.200	654	879.816	679
		Total	3.673,18	**2.570.000**	***700***	**2.817.173**	***767***

Source:
1) DepKimpraswil 2001;

2) Ditjen Administrasi Kependudukan Depdagri, September 2007
Note: Java is inhabited nearly 60% of the total population of Indonesia, with increasing rate 1.49%/yr. The highest population is in Jakarta (14.440 people/km²), and the lowest population density is in West Papua: 8 people/km² (BPS 2010).

5.2. Case Studies

The following selected study cases will present examples of forest policy and management related to other relevant development sectors considering their commitment to the ecosystem approach in particular. This covers various issues/policies regarding forest functions arrangement and management.

5.2.1. Case 1 - Forestry and Watershed Management:

Forest Land Rehabilitation Program for the Wonogiri Reservoir

This study case deals with the problem of sedimentation in the Wonogiri Reservoir reflecting inappropriate land use management in the upper Basin and inadequate cooperation of different land use sectors. In this respect it demonstrates the management challenges concerning an ecosystem approach.

a) The case

The Wonogiri Reservoir was established in 1982 for multiple purposes, particularly for flood control, for clean water supply and as electricity power plant. The Wonogiri Reservoir is located in Sub Das Solo Hulu (upper Basin) with characteristics as follow: volcanic origin soil (alluvial soil) which is highly fragile to surface soil erosion. The type of soil in sloping Mt. Merapi and Mt. Lawu as well as the upper valley of the Basin is very suitable for growing rice (see Table 5.1). In line with the increasing population pressure (see Table 5.7), paddy areas slowly but surely shift to dry land farming and then are transformed into settlements (see Table 5.3). Forests cover about one-fourth of the catchment area, and are predominantly assigned to permanent production function (17%) while only 2 % of the total catchment area is designated for protective functions (see Table 5.6).

The Reservoir was expected to have 75-100 years lifetime. However, it was rapidly filled with sediments transported from the catchment. In the mid 2001, just 20 years after the establishment, a 'surge prevention project' was proposed to dredge about 250.000 m^3 of sediments that closed the portal channel in order to save the inflow. In early 2004, a proposal for future prevention of sedimentation in the Wonogiri Dam was launched, including a watershed conservation plan (JICA and DepKimpraswil 2004).

According to a study that modelled the surface water runoff in the upper Solo Basin (Alif Noor Anna *et al.* 2010), the intense change of land use is the most significant parameter that causes increased surface runoff in the study area. Land use has changed from cultivated areas with forests to settlements with mixed gardens and from rice paddies fields to settlements (partly with home gardens). Even desiccated river areas have been converted. This has reduced the surface infiltration capacity and caused flooding in Solo, Sukoharjo and Sragen in 2008. It is also indicated by the change of the runoff coefficient (Co), particularly in the sub Basin Pepe which has an outlet in the city of Surakarta.

Another study (DepKimpraswil 2004 and personal communication) emphasizes, that the unfavourable development in the Wonogiri Reservoir was not only caused by inappropriate land use change, but also due to missing mechanisms for coordination and integrated watershed management between the Bengawan Solo Water Council (under Public Work, Ministry of Infrastructure and Settlement) and the Watershed Management Agency/BPDAS (before: Land Rehabilitation and Soil Conservation/BRLKT) under the Ministry of Forestry, although the concerned office locations are just tens of meters apart.

According to JICA and DepKimpraswil (2004), massive investments in reservoirs, dams, irrigation systems, water supply works, and flood control structures are jeopardized by the effects of decades of inappropriate urbanization processes in the Bengawan Solo River Basin's uplands. Such structural measures are technically effective just for the first couple of

years. After that, much depends on non-structural measures like broadening forest/vegetation cover, particularly on steep slopes, or green belt improvement. Hence watershed conservation plans that combine both of these measures and involve community participation were suggested.

b) Conclusions and recommendations concerning forest functions arrangement and management

Natural erosion risks and the protection functions of land cover / land use types for soil and water have to be considered. This involves at least two essential degradation indicators, namely forest conversion in upper lands into agriculture land, plantations or settlement areas on the one hand; and extreme water fluctuations between dry and wet seasons on the other.

In this respect, Sudradjat (2011) identified the following coherences in the BS Basin, based on land use simulation by using hydrology and environmental geology modelling:

- Land use change from forests into plantations (including tree gardens), mixed- and home gardens, rice fields and settlements causes flooding (peak and volume).
- The flood volume from sub-rivers also depends on the type of soil and hydrology characteristics like elevation and river's length.
- Potential flooding areas are located in sub-basins with soil types of high infiltration capacity (infiltration area) and also in lower sub-basins with soil types of less infiltration capacity.
- The current land use composition in the lower Basin, where the land use for residential and shrubs increased simultaneously with the decrease of land for rice field, orchards and forests, caused a greater flood compared to the composition before 1964.
- Restore land uses into forests with better respective function capacity, at least in particular areas in combination with the implementation of Low Impact Development (LID) will significantly reduce floods (in peak and volume).

Four different situations concerning the relations between land uses and land capacity have been identified in the study area (Sudradjat 2011):

(1) Land use that is appropriate for the land capacity (no area identified to represent this category).

(2) Land use in fragile areas with medium capacity (like the areas that have affected sedimentation to the Wonogiri Reservoir, including Cawas, Wonogiri-Eromoko, Giriwoyo, Tirtomoyo, Slogohimo and, Wonokerto).

(3) Areas with low land capacity and should not be developed (including Cawas, Eromoko, Tirtomoyo, Slogohimo, and Wonokerto)

(4) Areas with rehabilitation needs concerning protective functions (including Boyolali, Klaten, Gresik, Solo, Madiun, Magetan, Ponorogo, and Tuban.

These areas were targeted in the national FLR program–which was conducted from 2003 to 2007. Based on own observations, there was no strong mechanism for rehabilitation at the field level. Likewise, the own observations revealed that, although the seeds had been prepared and provided by each local district (for example. in Wonogiri), there was only rather limited participation of each community. Planting success is usually carried out under the coordination of the Head of the District. Generally, the Head of the District asked the local military forces. Even worse, and in flagrant contradiction to the rehabilitation agenda that was declared later, the Bengawan Solo Water Council /BBWS under the Ministry of Infrastructure and Settlement cleared up all relatively old plants (planted 30 years ago) in the green-belt areas of Wonogiri Lake in 2003 (*Suara Merdeka* 2013).

All in all the study case demonstrates, that

(1) Urbanization processes and respective land use changes may lead to major sedimentation and flooding problems. Thus FLR programs need to address the entire catchment area and involve cooperation with other institutions that determine land use.

(2) Critical areas, like peat-swamp and other water retention areas or river and lake buffer zones, have to be considered with respect to their key role in hydrological processes and respective regulation functions. However, they are still not indicated under the forestry law system. In fact, only the Spatial Planning Law indicate them as protective sphere, providing the criterion and the management model.

(3) The obvious lack of formal or informal direct communication and collaboration between the Watershed Management Unit of the Forestry sector and other respective administrative units has to be overcome.

5.2.2. Case 2 – Forestry and Segregative Nature Conservation: The Designation of Conservation Areas

The following case presents a re-designation of forest conservation areas to National Parks of Mount Merapi and the Mount Merbabu complex. This redesignation of forest function areas refers to MoF No.134/2004 and No. 135/2004 which respectively cover area about 6.410 ha and 5.725 ha.

a) The case (case 2a)

The redesignation of Mt. Merapi and Mt. Merbabu from a former Nature Reserve, Protective Forest, and Nature Recreation Park into a National Park has created pros and cons. The new designation came from the central government, i.e. MoF while the cons came mainly from local communities and NGOs. They argued that some designated National Parks in Indonesia have been merely established based on economic considerations e.g. flows of trans-national capital rather than environmental reasons and those they have lead to various degrees of degradation of those national parks (Haryono 2006). Natural Parks in Indonesia are managed by the central government. Their designation often changed former borders affected silviculture or impaired local communities' access to the forest resources which they had relied on for generations. In many cases the central government gave even licenses such as for mining activities, although the forest area was meant to be protected (Tempo 2002). Insofar, the designation of a National Park will not necessarily guaranty environmental sustainability. It might even risk worsening the level of degradation.

Actually, the designation of a National Park should follow the existing natural conditions of the area. Usually a zoning system is implemented, and previous Nature Reserves are indicated as core-zone (*zona inti*), the previous protective forests as buffer-zone (*zona rimba*), the previous Nature Recreation Parks (*Taman Wisata Alam*) as utility-zone (*zona pemanfaatan*) and other relevant zones might be preserved to maintain tradition, as rehabilitation area, for religion purposes or for other special purposes.

Referring to Government Regulation No. 68/1998 on Natural Resource Conservation and Natural Area Preservation, a core-zone of a National Park shall be inclusively in natural condition and undisturbed by humans. The previous Nature Reserve of the Mt. Merapi which only covered 165,75 ha was presumed to be undisturbed and in natural condition while in the case of the Mt. Merbabu, there is no such area, and the remaining protective forest consisted of plantation forests. In this respect, it is most remarkable that a small area of undisturbed natural forest in the Mt. Merapi National Park and plantation forests in the Mt. Merbabu National Park have been designated as core-zones. In addition, according to some academic experts, this procedure violated against the law, particularly because no Environmental Impact Assessment (*Analisa Mengenai Dampak Akan Lingkungan*) nor a people consultation process were conducted, although they are both stipulated in the Law No. 23/1997 on Environmental Management; article 5 (Kompas 2005). Referring to the UNEP World Conservation Monitoring Centre (WCMC), these areas have not even been mentioned as protected areas (Whitten *et al.* 1997).

However, according to MacKinnon *et al.* (1982 in Wikramanayake *et al.* 2002), another 15.000 ha of the Mt. Merapi and Mt. Merbabu were proposed as recreation forests rather

than other conservation types. Since Mt. Merapi is situated north of Yogyakarta, one of Java's larger cities is very attractive for recreation purposes.

All in all, the designation of the Mt. Merapi and Mt. Merbabu as National Parks in the Western Java Montane Rain Forest ecoregion seems to be incompatible with Law No. 5/1990.

b) Conclusions and recommendations concerning forest functions arrangement and management.

Policy can give a strong and direct impact on forming the landscape e.g. through designating different types of management intervention. In the presented case, the category of a National Park does not match with the actual conditions of the area. Such inappropriate designation has the potential to be contentious; not only for the management of the area but for all stakeholders.

Efforts to conserve nature are not automatically accepted in the society. A social process and adequate accompanying studies should be implemented to reduce potential conflicts.

Basically the conservation status of the entire ecoregion is categorized as critical, and a high level of protection of the respective areas is crucial. An appropriate protection status may follow category III (National Monument) by IUCN (Kozlowski and Peterson 2005), where high levels of protection exclude incompatible extractive uses in face of their natural, cultural and aesthetic richness. This kind of protection status is also essential for the preservation of biodiversity and for providing the necessary information for monitoring change.

a) Another case (case 2b)

The following study case is another area designation that has been considered as incompatible. From the juridical perspective of designation, Mt. Lawu (under Eastern Java Bali Montane Rain Forest ecoregion) is not yet preserved adequately, although a primate species population in this area is ranked among the rarest and most endangered primate species in the world. Consequently Mt. Lawu has been proposed by WCMC to be protected (Whitten *et al.* 1997). Primate species can be taken as an indicator for ecosystem health. The broad geographic perspective of the Sundaic Shelf region is important in this respect as it harbours a disproportionately large number of primate species and primate endemics (Mittermeier and Konstant 1996/1997 in Nijman 2001).

Most primate species are confined to natural forests like the ebony leaf monkey/surili (*Presbytis comata*), formerly called *P. aygula*. But all respective decrees to preserve them (MoAg Decree No. 247/1979; MoF Decree No. 301/1991 and No. 882/1992) just focus on the species and do forget about their habitats.

P. comata is known to be strictly arboreal - as one of the principal arboreal shoot- and leaf eating mammals of the Javan rain forest (Medway 1970 in Nijman 2001). Fruits are also eaten when available (Sujatnika 1992 in Nijman 2001). The habitat is primary or secondary forests, with a preference for younger plantations rather than mature forest stands (Supriyatna *et al.* 1994 in Nijman 2001). However, degraded forests or plantations may not guarantee that the species can survive for a long period of time. The distribution pattern is in mixed-lowland to hills-rain forests, and montane ever-wet forest with a vast majority of records originating from the wettest areas.

Their habitats have been destroyed and, based on IUCN Category, the species has become 'endangered'. 33 forest patches of their habitats have been identified all over Java, from Ujung Kulon in the west to Mt. Lawu in the east. Fossils have been found in Middle Pleistocene deposits (collected by Eugene Dubois) in Mt. Wilis-Liman (eastern Mt. Lawu). It shows that this species was previously extended further eastward than Mt. Lawu. The populations are supposed to have disappeared due to a volcanic eruption from Mt. Wilis. In the Bengawan Solo River Basin, the remnant population is only found in the far east of Mt. Lawu at 1000 – 3000 m a.s.l. at the border between East and Central Java (Bartels 1937 in Nijman 2001).

Some authors argued, that *P. comata* in Mt. Lawu was synonymous with *P.c. fredericae* and therefore categorized it as sub-species. Based on a study in 1994 - 2001, IUCN categorized it as 'data deficient'. Due to the geographical variation, other authors alleged that differences between *P. comata* and *P.c. fredericae* could hardly be found in diagnostics, because some intra-species variation is such a clinal nature (slowly change). In order to preserve this intra-species variation, it is about time that all remaining populations and their habitats, especially those in Central-Java become actively protected. If the *P.c. fredericae* should not be synonymous with *P. comata*, it would be ranked among the rarest and most endangered primate species in the world, restricted to 4 isolated forest areas including Mt. Lawu (Nijman 2001), making it a top priority for primate conservation (Brandon-Jones 1995 in Nijman 2001).

However, up to current time, their forest habitat in Mt. Lawu is not yet adequately protected, although the population size has been estimated to be declining. Theoretically it has been calculated in a range between 8040 (MacKinnon 1987 in Nijman 2001) and 2285 individuals (Supriatna *et al.* 1994 in Nijman 2001).

Overlaying their current distribution with the current forest function map of Mt. Lawu, the area is designated as Protective Forest concerned with water and soil protection and managed by the state forest company Perhutani. The vegetation cover is secondary dry land forest and plantations (pinus and acacia). The land cover of Mt. Lawu is dominated by

vegetable agriculture even on the steep slopes. There is no appropriate management provision for the preservation of *P. comata (fredericae)* or for their habitat.

Different from the habitat requirements of *P. comata* a species which is strictly arboreal and will become extinct if the forest is cleared up, a primate species like *Macaque fascicularis* or long-tail macaque is able to survive in man-made habitats. During the dry season of 2004 in the Sukoharjo Regency (Central-Java), thousands of long tail Macaques was not only attacking the farms but also the villages and villagers after no food could be found on the farms. Shortage of water and food in the (southern) mountainous forests was regarded as the source of the problem (*Kedaulatan Rakyat* 2004). Referring to MoF Decree No. 618/1996 on the Population Management of non-protected Wild Animals, *M. fascicularis* is nowadays categorized as 'pest'. This fact apparently shows that a conflict with respect to natural resources can also appear between humans and animals. This leaves no other conclusion than to rehabilitate their habitats and to control the population.

b) Conclusions and recommendations concerning forest functions arrangement and management

Both cases illustrate that the conservation concept in the Indonesia forestry sector must be altered with regard to the following issues:

(1) There is not only a fatal lack concerning the legal support for species conservation through habitat protection, i.e. in considering the habitat of endangered species as essential requirement for their survival; but also a lack of wildlife management concepts in cultural landscapes. The *P. comata* population in Mt. Lawu has not even been recognized in the management record of the East Java Nature Conservation Agency (personal communication 2004), because its habitat is managed under the water and soil protection function.

(2) To control boom populations of aggressive species like M. fascicularis is needed to protect farms and farmers. An appropriate hunting program to control the population growth within a formal wildlife management framework should be considered. This of course, would also have to include the appropriate preservation of their original habitats.

5.2.3. Case 3 – Forestry and Integrated Nature Conservation issues: SFM Certification of (Teak) Plantations

a) The Case

In the year 2000, some of the 57 Forest Management Districts (FMDs), namely FMD Madiun, FMD Cepu-Kebonharjo-Mantingan, FMD Lawu Ds and FMD Kendal were applying for Sustainable Forest Management (SFM) certification under Smartwood as certifier. Those first three FMDs are all located in the BS Basin.

Based on the public summary on SFM Certification Program in Perhutani released by SmartWood[17] (2000a, 2000b, 2000c), various information can be acquired focussing on the forest management (control) system, the arrangement of forest functions related to biodiversity issues and environmental impacts in particular, as well as social aspects:

Concerning the forest management (control) system, Perhutani follows a strict planning regime. With respect to silviculture, all FMDs follow Perhutani's management principles that are formulated in the Jakarta headquarter and conveyed to the Unit and from there to the FMD. Detailed plans are handed down through the chain of command with little modification. All districts share the same procedure, implicating little differences between FMDs in terms of management, planning, operation, staffing etc. Further uniformity in management is ensured by the rotation of district administrators and other senior staff every 3 - 4 years. This reinforces a very homogeneous approach with planners and operation managers taking little consideration of local conditions. Usually, local variation is more noticeable with respect to social aspects rather than due to environmental differences.

The following findings are related to environmental impacts and biological conservation for each assessed FMD:

1) FMD Madiun

The Madiun FMD is located in Unit II (East Java). The upland area has traditionally been non-productive for agriculture due to steep topography and poor soil conditions. The teak plantations which constitute the bulk of Perhutani's holding occur at altitudes of 600 m and upward. The total area encompasses 31.264,3 ha consisting of production forest, protective areas and special purposes areas. Based on the planted species, this FMD is divided into 2 main classes, namely teak and eucalyptus which cover about 27.528,2 ha

[17] SmartWood is an accredited certification body by the Forest Stewardship Council (FSC). Perhutani chose the certification program under the SmartWood program to recognize conscientious land stewardship through independent evaluation and certification of forestry practices. The purpose of the assessment was to evaluate to what extent Perum Perhutani's districts are managed in an ecologically responsible, economically viable and socially responsible manner.

(88%) and 3.736,1 ha (11,9%) respectively. Some other species have been planted in small amount: *Swietenia spp*. (mahagony), *Dalbergia latifolia* (*sonokeling*) and many others.

According to SmartWood (2000c), the forest is non-contiguous and highly fragmented into more than 20 patches. Two 'nature reserves' have designated by Perhutani. As known, Perhutani does not responsible on conservation area. The category of Nature Reserve is under conservation function (see Table 4.5). In addition, these nature reserves have reported 'no appropriate nature conservation management' and there is also no interference from Nature Conservation Agency (BKSDA).

One in the sub-district Bungus is dominated by teak and does host some wildlife such as *kijang* (deer), wild pig, wild chickens, tiger, snakes, birds and monkeys. Activities to support the conservation of animal species by an inventory of wild animals, hunting control and researches are still limited and corridor concepts for landscape based ecosystem conservation of wildlife are still not well known. No data baseline on biodiversity on the landscape level is addressed nor measures against human pressures that have seriously undermined the biodiversity.

Also riparian protection is still not implemented in the respective FMD. The designated riparian buffer zones where timber harvesting is prohibited and the great diversity of native tree species shall be preserved were neither clearly marked in the field, nor in maps.

2) Cepu-Kebonharjo-Mantingan FMDs

Cepu FMD, Kebonhajo FMD and MantinganFMD are located in Unit I (Central Java). These three FMDs consist of natural and plantation teak stands and a smaller portion of other mixed hardwood species. Again, the upland areas have traditionally been non-productive for agriculture due to steep topography and poor soil conditions. Each area is dominated by production forests: Cepu 92,5%; Kebonhadjo 92,9% and Mantingan 97,8% of the total area 33.109,9 ha, 17.653,8 ha and 16.535,1 ha respectively. Nearly 100% of the production is teak. Other commercial species include mahagony (*Swietenia spp.*) and sonokeling (*Dalbergia latifolia*).

According to SmartWood (2000a), these FMDs show similar conditions like the Madiun FMD: insufficiently contiguous blocks for wildlife protection, rather limited activities to support wildlife protection. No adequate attention for riparian corridors along permanently flowing streams.

3) Lawu Ds. FMD

Lawu Ds. FMD is managed by Unit II (East Java), an area that has traditionally been productive for agriculture due to volcanic activity and generally good soil fertility. The total

area covers about 51.348,9 ha of production forest (47,4%), protected forest (51,5%) and special purpose land (0,01%). Differing from the above mentioned FMDs, the dominant species is pine as a resource for timber, softwood pulp and fibre, turpentine and *gondorukem*. Other commercial species are mahagony, albizia, and sonokeling. *Pinus merkusii junghet devries* (also called *Tusam*) was chosen because of its ability to colonize degraded land and to grow rapidly across many climate types and a wide range of soils.

According to SmartWood (2000b), the Lawu forests provide potential ecological functions, particularly for watershed protection, carbon sequestration, mitigation of soil erosion and other. The original pine plantations were planted is mixtured with rasamala, puspa and others. Some endangered species like peacock, lutung monkey (*P. comata*), *Panthera pardus*, *Gallus gallus*, barking deer have been reported. However, the forest management regime tends reacting neutral or passively to wildlife. An increasing pressure on the forests is caused by local people due to grazing, fuel wood collection, hunting, non-timber forest product collection and the desire to change pine plantations into agricultural fields.

The major portion of Lawu FMD is protective forest. The need for hydrological protection with respect to spring water is accentuated for this area. Activities to support wildlife protection lack the same attention like in the FMDs mentioned above.

b) Conclusions and recommendations concerning forest functions arrangement and management

The uniformity of instructions for state forest management still leads to systematic failure concerning forest functions arrangement, at least with respect to integrated conservation issues. Their consideration, apart from traditional forest production has been initiated late and the respective decrees are substantially inadequate and do not follow a modern approach of landscape based population ecology.

Potential nature protection functions have been recognized with respect to swamp forests, watersheds, coastal areas, including their threatened, rare, endemic or endangered species. Hunting those species at riversides, lakes dams and watercourses has been forbidden, while Perhutani has been asked to develop and improve strategies and additional provisions concerning wildlife management and nature protection planning and monitoring.

Conventionally, timber is the particular target commodity from forest plantations that are usually planted as monocultures which are considered as ecologically inappropriate due to their rather limited biodiversity. Nonetheless, cultivated landscapes and manipulated forests like teak and pine forests also do function as important habitats for various animal species and diverse plant communities that have been pre-adapted or acclimatized to more than hundred years of plantation management. Undoubtedly, there are many ecological

differences between plantations and natural forests. But essential conservation opportunities will remain disregarded if the simplifying view is adopted that plantation is ‘bad’ and natural forest is ‘good’. Instead, plantation management needs to integrate nature conservation issues and determine factors to increase habitat diversity on the landscape scale, for instance by leaving the non-commercial vegetation along streams and rivers instead of clearing it uselessly. Although plantations can never fulfil the same role like natural forests do, there is no reason to abandon them and forget about their habitat function. In fact, where plantations replace critical grasslands, ecosystem complexity rather increases. Plantation species should also be considered because they may have desirable ecological effects, for example to soil characteristics, transpiration etc. Furthermore management objectives should not only consider production but also ecological aspects of species selection (Whitten et.al 1997).

5.2.4. Case 4 - Forestry and Local People’s Benefits: Community Forestry and Social Forestry

a) The case

The Forestry Law No. 41/1999 determines that government, business sector and communities do share the responsibility for forest program activities. The government is obligated to take the initiative and coordination as well as to develop appropriate institutions. The business sector has mainly obligations concerning investments. The implementation is realized at the local government (regency) level, by institutions like the Forestry and Soil Conservation Agency (*Dinas Perhutanan dan Konservasi Tanah/DPKT*) and coordinated by the Chief of regency (*Bupati*).

Since 1995, the government has undertaken a number of efforts to encourage the role of local people. In many countries, social forestry is understood as community-based forest management to improve people’s prosperity. Social-forestry in Indonesia was first introduced in the 1980s on forest estates (state owned forest) and on private land under the name *Hutan Kemasyarakatan/HKM*. The Forestry Department makes a difference between ‘Community Forests’ (*‘Hutan Rakyat’*) and ‘Social Forestry’ (*‘Perhutanan Sosial’*). The Ministry of Forestry maintains them in two different Sub-directorates, namely for Community Forests (*Sub-direktorat Hutan Rakyat*) and for Social Forestry (*Sub-direktorat Perhutanan Sosial*).

Area responsibilities of Soil Conservation Agency (DPKT) are located particularly in the protection sphere, but encompass also non-wood products, ruling the traditional hunting of wild species which are not protected in hunting areas, forest preservation and community capacity building in forestry. In practice, the supervision target is limited on privately owned

forest land or called ‘community forest’ (*hutan rakyat)* - or ‘tree forest’- areas related to water and soil protection or non-wood products.

Part of the SFM Certification Program in Perhutani released by SmartWood (2000a, 2000b, 2000c) reported as well about the social aspects on forest management:

In the state owned forest, Perhutani did already improve the social responsibility since the 1990s. Traditionally, local people have used the forests to supply fuel, fodder and non-timber products such as medicinal plants and food while they have been excluded from using teak as the main product. Basically, the local community understands the access rule to forests. Perhutani and the local communities usually maintain good relations and even try to improve them through *tumpang sari* or *taungya* system.

However, some timber theft incidents happened and became more common during the monetary crisis and the subsequent political moil. Consequently, Perhutani was asked to develop a publicly accepted and consistent method of reporting and handling such conflict situations. This would require formal local consultation processes, conflict resolution’s procedures, including legal processes and compensation. So far, real community participation has been a challenge in forest management, particularly concerning local economic benefits by giving access for agricultural land and non-timber forest products as well as reforestation.

Another and even worse kind of social conflict occurred during field investigations: Due to double occupation of lands around 500 families may claim Perhutani’s lands through letters issued by the National Land Authority. This conflict reflects again that coordination between different sectors, integrated planning and joint mapping as guidance for all development sectors are still urgent issues that need to be solved.

Differing from social forestry, community forests are practiced on private land belonging to individual smallholders. Participation is seen as essential in order to plant trees outside forest estates.

The establishment of community forests can be divided into three types of financing:

(1) Subsidy: part or all of the costs are borne by the government. This option was introduced for land rehabilitation at the upper land of watersheds (Kredit Usaha Konservasi Daerah Aliran Sungai/KUK-DAS, Inpres Penghijauan, and Gerakan Nasional Rehabilitasi Hutan dan Lahan/GNRHL);

(2) *Swadaya*: costs are independently borne by farmer. Species selection is usually market oriented. For this purpose, a Community Forest Credit Scheme (Kredit Hutan Rakyat) is available, for instance providing up to Rp. 2 million/ha, with 6% annual interest. To follow this scheme, farmers must cooperate and create a total planting

area of 900 ha. They must also find a competent business partner to administer the loan (MoF Decree No. 49/1997);

(3) Cooperation: the farmer cooperates with wood-industries supported by the local government (province and regency). The MoF encourages farmers to avail themselves the Standard Agriculture Credit Package Scheme through a cooperative credit (i.e. Kredit Usaha Tani/ KUT), for instance to plant trees along their agricultural crops. The goal is to improve the role of smallholders in tree-crops planting. They are not confined to the MoF, but to the Ministry of Agriculture. Tree species are mainly agricultural trees, namely coconut, rubber, coffee, oil palm, cashew nuts and cocoa trees. The Ministry of Agriculture offers programs for permanent farming (Usaha Petani Tetap) and for conservation of natural resources (Usaha Pelestarian Sumberdaya Alam), to settle shifting cultivators and get them to convert upland fields and ylang-ylang grasslands to permanent tree crop cultivation.

Social forestry has been practiced in Java since long time ago under the estate forest canopy of Perhutani. Perhutani follows an annual harvesting plan based on area. Volumes are calculated from the actual volumes of the standing timber in the blocks scheduled for harvesting in a particular year. They may vary from year to year as the blocks are harvested. Blocks depending on age criteria for harvest are further scheduled according to their volume of standing timber to meet volume requirements. The locations to be felled are selected to be consistent with the annual allowable cut based on an 80-year rotation. Perhutani has developed a wide range of silviculture techniques to ensure the development of good quality stands of teak, and several other species. A management guideline is issued by the Jakarta offices or by the respective unit and district administrators, addressing germination, tree spacing and species mix for planting, branch pruning and intensity of thinning, as well as cutting cycle theories to determine the optimal age for harvest. The system of 3 x 1 meter planting which has been in use for the last century in the teak plantations is currently being adapted to accommodate more intensive use of inter cropping for agro-forestry. More common now is the use of 3 x 3 spacing, which means that the canopy does not start to close and minimize light for the under story crops after the first two years. For over a century, *tumpang sari* or *taungya system* crop-allied planting on forestland has allowed local farmers to plant agricultural crops in tree seedlings plantations, normally for three years before the canopy began to close. This system integrated local community members most effectively and provided them with agricultural land.

Tumpang sari is practiced in various locations in Java with support from the Ford Foundation, Perhutani and their advisors have developed a revised social forestry strategy: In 1984 the present programs of Integrated Community Forest Development (*Pembinaan Masyarakat Desa Hutan Terpadu/PMDHT*) was introduced. It allows farmers to plant fruit

trees within plantation areas, to enhance Non-Timber Forest Product (NTFP) production, and gain income from thinning operations. This program allows cultivators to get greater benefits from NTFP and from a choice of trees they are allowed to plant for their own profit. The goal of the approach was also to allow farmers to hold a long-term stake in the economic future of the plantation. The program also sought to build forest farmer groups (*Kelompok Tani Hutan/KTH*) represented by social forestry managers in negotiations with Perhutani. As a group, rather than as individuals, they should be more powerful concerning the planning and decision making process. The rights to harvest timber are excluded in all these programs.

They were introduced because the population densities in the forested lands of Java increased, particularly after World War II. Many of Java's forest districts were targeted for reforestation since they were no longer sufficient to meet the needs of the growing population of landless agricultural laborers. The success of the strategy was indicated by lower rates of forest arsons, timber smuggling, and violence between community members and Perhutani staff until the first half of the 1990's. After that, the situation changed. Poffenberger (1998 in SmartWood 2000b) suggested that Perhutani should delegate planning and management of reforestations to the communities.

The community forest and its incentive schemes as well as social forestry are examples of community participation in forestry. A similar scheme is also found in the agriculture sector but more accentuating on food production.

b) Conclusions

(1) Choice: Community forest is realized by people based on their self interest like on plant in their own land, select species and also select from the different facilitations or credit schemes which are offered by the government and the business. The Democratization is also presented in the revised social forestry by Perhutani which allows farmers to plant fruits trees under agroforestry system.

(2) Inter-sectoral Collaboration: The MoF encourages farmers to avail themselves of a cooperative credit (i.e. *Kredit Usaha Tani/KUT*) such as tree-crops planting while they are not confined to the MoF, but to the Ministry of Agriculture. In addition, the 'tree-crop' program (and revised agroforestry system) can improve landscape ecology in agriculture areas, for instance by providing migration and refuge corridors or feeding ground or guide the movement of materials, water, wind and energy.

(3) Participation: Participation in community forestry is seen as very important for planting trees outside forest estates. Participation is presented also in the social forestry program which attempts to build forest farmer groups (*Kelompok Tani*

Hutan/KTH) and negotiate with the respective chosen managers as representatives. Decisions are made as a group rather than as individuals.

5.2.5. Case 5 –Transportation Infrastructure Development and Forestry: The Strategic Road Infrastructure Project (SRIP)

a) The Case

The following study case deals with the Strategic Urban Road Infrastructure Project (SRIP), which was initiated by the Department for Infrastructure and Settlement in cooperation with the World Bank. It is focussed on the role that Urban Forests could have in such kind of infrastructure project, provided that inter-sectoral cooperation and awareness of environmental interdependencies would be practiced effectively.

The SRIP project was designed to respond to the traffic jam phenomena in Indonesia, especially in Java, where transportation costs are amounting to 17% of the total costs of export products, being the highest in Asian countries (DepKimpraswil 2004). The primary goal was to reduce bottle-neck problems in some urban areas by new roads construction, roads improvement, better maintenance, bridge replacement and increment of road's capacity.

In terms of environmental and social care, SRIP had to follow Law No. 23/1997 on Environmental Management and Law No. 5/1992 on Cultural Monument and the respective regulations, and in addition WB-Safeguard Policies, including public consultation for Environmental and Social Safeguards, as well as Environmental and Social Assessment and Management Plan (ESAMP). The background of these requirements in particular is to protect environmental features, but only during the project run. They shall also reduce social impacts caused by the project's implementation, which in this case was mainly land acquisition.

Public consultations on SRIP were mostly focussed on land acquisition and its compensation as the leading topic. Mitigation measures concerning environmental impacts of the operating roads after the project would be finished have never been an issue. Air and noise quality could be improved locally by providing new by-pass roads to enhance traffic flows. Monitoring surveys conducted before (1995) and after (2003) construction measures indicated a general reduction in the levels of all measured parameters, including noise, dust, hydrocarbons, CO_2, NO_2, SO_2 , and lead, ranging between 5% and 13% (DepKimpraswil 2004).

However, this approach diverted traffic and emissions from existing routes to more remote areas. Apart from the deterioration of life quality in the affected areas fur humans, such kind of pollution and disturbance is one of the main threats to biodiversity, particularly to water biodiversity (rivers, lakes, coastal and ocean areas) and their fauna, flora and entire

ecosystems. According to Dahuri (2003 in MoF 2009), transportation is one of the main sources of pollution beside industry, agriculture, and home activities. Furthermore, a densitified road-net divides a coherent area into smaller, increasingly separated patches. Without implementing a corridor concept for wildlife, habitat isolation will become an issue. According to Campbell and Reece (2007 in MoF 2009), habitat fragmentation will reduce the size of populations and make them more vulnerable to disturbances. According to SoER Indonesia (2007 in MoF 2009), it will also increase conflicts between human beings and wild life.

According to the representative officer from the Department of Infrastructure and Settlement, there was neither consultation nor coordination with the forestry sector at all, although the Forestry Law (article 9) indicates functions of Urban Forests for various objectives, like regulate micro-climate, maintain aesthetic values or providing space for water infiltration. In this respect, Urban Forest Functions are arranged differently compared to designated forest functions elsewhere. According to the Ministry of Home Affair, Decree No. 14/1988, Urban Forest is considered as an alternative to Green Space Area (GSA), which is defined as 'an open space area (without building) in cities, either in block or in strip form, of grown plants either natural or cultivated, like agriculture, garden plantation etc'. Urban Forest is also determined in Government Regulation No. 63/2002 as 'an area with compact and closed vegetation cover in urban areas, either located on state-owned or private-owned land, and designated as an Urban Forest by the respective authority'. Location and size of Urban Forests are decided by the chief of regencies/cities *(Bupati/Walikota)* but should be based on the spatial plan of the respective district, in addition to GSA. Appointments concerning Urban Forests consider four aspects, namely city size, number of citizens, level of pollution and physical condition of the city. According to Government Regulation No. 63/2002 (article 3) the functions of Urban Forests are: to improve and maintain the micro climate and aesthetic values, to as water retention, to create balance and harmony of the physical environment of the city, to support biodiversity. These functions can be proposed in settlement areas, industrial areas, recreation areas, genetic resource preservation areas, protective areas and areas that were built for security (article 14). However, this Urban Forests Regulation does not mention urban forest for road impact mitigation, such as absorption/filtering of air pollution, noise, light and annoying views. Furthermore, no kind of operational guideline for inter-sectoral cooperation and coordination or for planning adequate forestry measures has been stipulated by the forestry sector so far.

b) Conclusions

Like similar road construction projects in Java (for example the ADB-funded North Java Road Improvement Project NJRIP), the SRIP demonstrates that more careful and inter-

sectoral preparation is needed in order to better integrate environmental and social issues. First, the Regulation No. 63/2002 on Urban Forests needs to be amended specifically the role of urban forests in mitigating the road impact; and second, the need to prepare transparently information and mitigation efforts of road impact issues to the public.

Urban Forest development in Indonesia is still facing various problems, mainly due to sectoral conflicts with respect to land availability. This problem does occur because of the high economic value of lands in urban areas, and at the same time still low awareness and appreciation concerning the role of Urban Forests, from the public, the administration as well as from the government. The common consequence is a conversion of the existing forests and trees-stands into other utilities and resulting treeless areas (Dahlan 2004).

Due to decentralization, greater responsibilities than before are held by the local governments which need to be involved. More attention should also be paid to community consultation, especially in the stage of preparation.

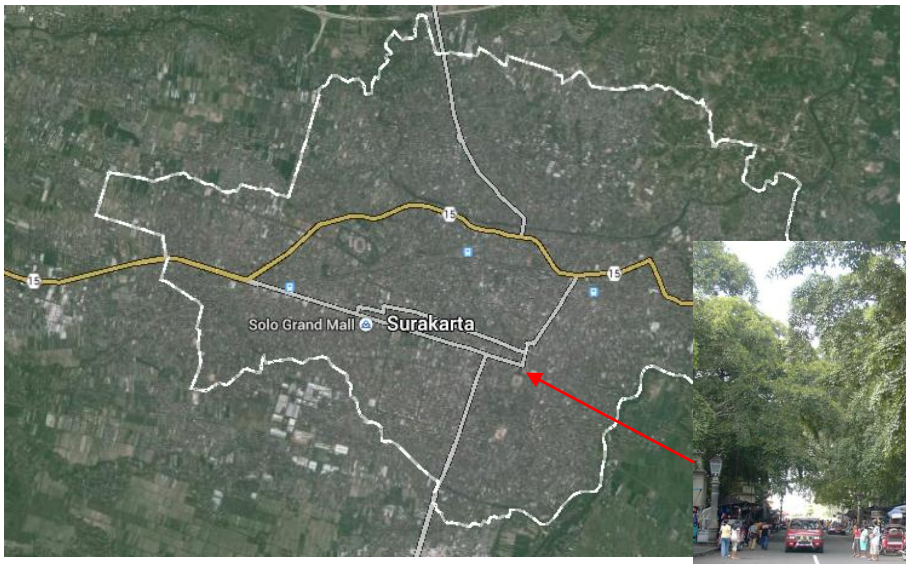
5.2.6. Case 6 - Local Government, Regional Development and Urban Forestry

a) The Case

Different with the case 5, this case of Urban Forests is related to local government. Urban green in Indonesia (including trees and remaining forest paths in the urban environment) is managed by dedicated administrative departments for urban landscaping (*Dinas Pertamananan*) under the local government responsibility. The forestry sector is excluded and has no influence on planning and implementation. Under these circumstances, the current practices of urban forest development at regional level might be incompatible with the goals and principles of the ecosystem approach in an area that gets more and more urbanized. Landscape architects concentrate on single trees, their site and maintenance requirements, resilience, growth forms and aesthetical value. Environmental functions, like filtering air pollution, absorbing and mitigating noises, or shading and heat regulation are neglected (see case 5) and most unlikely considered in their spacious context and effects.

Figure 5.5 (right) gives an example of old growth trees (*Ficus benjamina*) found in Kota Surakarta. The old trees do still exist because people still do believe in the natural spirit of the trees. As sacred such tree stands are rare, but much sought after by shop keepers and rick sags operators who benefit from the shade during the day.

Figure 5.5 Photo Satellite Image of Kota Surakarta and Old Growth Trees in Kota Surakarta



Source: Sattelitephoto Google maps, 2014

Source: Private photo 2003

Surakarta municipality (Kota Surakarta) covers an area of about 44 km^2 supporting more than 500.000 inhabitants. As a medium sized urban area, it is located in the Upper Solo Basin (Sub-Basin Bambang), where the area has been rapidly urbanized. According to Alif Noor Anna *et al.* (2010), this Sub-Basin is one of areas with the highest potential run-off due to land use change. New green space areas (GSA) are very important for the natural urban environment as well as for aesthetic and emotional reasons.

The Kota Surakarta's Regional Development Plan (*Rencana Tata Ruang Wilayah/RTRW Kota Surakarta* 1993-2013) was authorized by the Local Congress and consists of annual programmes (*Rencana Umum Pembangunan Tahunan Daerah/RUPTD*) which are designed based on a consultation process (consultation, coordination and confirmation). Related issues cover human resources, finances, business, management of the city development, culture and tourism, and living conditions of the city's urban society. The plan gives priority to land empowerment, increasing appreciation as well as sustaining traditional-culture and addressing social problems, business development, finance resources and regional income. Although decreasing living conditions have been indicated, and the Comprehensive Development and Management Plan for the Bengawan Solo River Basin (DepKimpraswil 2001) has stated the lack of integrated management for development as the main problem, including the municipality's development, the issue of urban forests and green areas remained excluded in the respective development plan.

However, in 2000-2012 under the city's major Joko Widodo, the city's development direction made an effort towards greening the area. Based on field observations at the end of 2011/ early 2012, tree planting along road's sides was actively implemented. Furthermore, rebuilding, renovating and reactivating most historical public areas and parks in the city, like *Taman Monumen 45 Banjarsari, Taman Balekambang, Taman Tirtonadi, and Taman Sekartaji* were included in the city's development agenda. Under the major's leadership, the city has committed to achieve 30% of the city area to be developed as Green Space Areas (GSAs) following the Spatial Planning Law requirement. As an impressive result, the city has reached already almost 20% of the total area to become GSAs (Kompas Jateng 2010). In the following five years, some old parks which have not been well maintained, like *Sriwedari, Manahan, Kentingan, Alun-alun Selatan, Solo Techno-Park* and *Lapangan Mangkunegaran,* will also be rebuilt. The Cleaning and Landscaping Agency (*Dinas Kebersihan dan Pertamanan/DKP*) under the city major has the responsibility to maintain them.

The historical Parks in Surakarta are usually dominated by old growth trees, which were previously untended, including the surrounding environment. Species selection for side roads greening or parks still consider more aesthetic reasons rather than also other purposes, e.g. noise reduction, pollution absorption, cover of undesired views, birds attraction or biodiversity improvement, etc.

b) Conclusions and Recommendations

Urbanization creates a high demand for land for settlements and infrastructure. As a result, procurement for open or green spaces might be seen as a waste, or at least as unprofitable although declining living conditions in the city have been considered and a minimum size of GSA has been stipulated in the Spatial Law. As described in CDMA (DepKimpraswil 2001), there is lack of integrated development. Not only the development of the city in the BS Basin context, but also in the context of the city itself.

GSA and trees are multi-functional: They promote water infiltration; regulate micro-climate; absorb pollutants like dust, CO2, SO_x; regulate noise; give shade, cover undesired views, provide recreation and enjoyment opportunities and improve people's attachment to the area.etc. In the above mentioned case, the historical parks in the city are collectively redesigned considering their social purposes. The forestry sector could provide valuable experience and knowledge for example concerning species selection by considering trees architecture, rooting, stability, or biodiversity effects.

Collaboration between the forestry sector, settlement and infrastructure development and the Cleaning and Landscaping Agency introduced by the local government concerning GSA is not yet established but could help to implement the value of GSA and trees in the

development programmes. So far, most activities and initiatives in this respect do depend on the executive leader, but not on mutual convincement and will.

6. Discussions and Answers to the Research Questions

This chapter is divided into three sections. The first section will discuss the findings of the study that have been presented in Chapter 6.1 and judge them according to their conformity with the ecosystem approach principles related to the relevant issues, namely management, area and ecosystems as well as stakeholders and economy. A final overview of this assessment is given in Table 6.1. The second section will discuss the strengths, weaknesses, opportunities, and threats concerning the current management in the forestry sector as to be seen from the perspective of the ecosystem approach. Finally, the third section will present the answers to the research questions that have been listed in chapter 1.6.2.

6.1. Findings Concerning the Consideration of Ecosystem Approach Principles in the Bengawan Solo Basin

The ecosystem approach shall be a basis for development by all development sectors in Indonesia. This commitment of sectoral management has various implications for many aspects concerning forest function arrangement, particularly by the forestry sector.

6.1.1. Adaptive Management

Adaptive Forest Management calls for appropriate awareness and consideration of, as well as reaction to ecosystem changes focussing on local variability and uncertainties and taking into account the respective spatial and temporal scale. The management system consists of organization structure, management goals and regulations, as well as guidelines, technical directions, and mechanisms to support the goals.

Principle 1 - Laws and regulations represent societal choices:

[conform: without specific hint; partly conform: complete set of supporting laws but need to improve the 'substances', to harmonize and to complement one to another (R); not conform: without specific hint].

The Indonesian constitution gives a mandate to the government to maintain all resources for the prosperity of the people. The Ministry of Forestry in particular is obligated to maintain forest and forestry related ecosystems (see chapter 4.3). The respective Forestry Law, and other related Laws concerning area management for ecological forest functions have been presented in Chapter 4. These laws and regulations provide goals and norms for management procedures elaborated by legislators that have been democratically elected by people. In this respect they do already represent societal choices. However, most of these

regulations do stipulate public participation on the local and regional level. Insofar they do encourage and respect local and regional societal choice

Principle 2 - Structural organization to the lowest appropriate level:

[conform: the organization is structured down to lowest appropriate level (R); partly conform: without specific hint; not conform: without specific hint]

The Indonesia forestry administration is structured down to the lowest appropriate level. The respective lower organizations that have been presented as responsible to affect forestry management in the study area are: BPKH IX for forestry planning in Java; BPDAS for watershed management; BKSDA for nature conservation and Perhutani for state forests outside nature reserves. The responsibility of these agencies is dedicated to the effective control over their authority area. These delegations for forest management, together with the decentralization from central government to the regency/city level improved the possibilities for all involved stakeholders to manage their environment with close and direct respect to the local issues.

Principle 3 - Environmental Impact Assessment:

[conform: EIA requirement (R); partly conform: sectoral or project scope case 5; not conform: absence of procedures (regulations /mechanisms) for the forestry sector (R)].

The Spatial Planning Law requires strategy development by all parties to prevent negative impacts that may impair social, economic and/or environmental conditions. The Environmental Protection and Management Law requires the formulation of a natural environmental management plan with respect to spatial planning and development.

Ecosystems are not closed systems, but rather open and often interconnected. All policy and development sectors have obligations to consider the possible effects of their actions to adjacent and downstream ecosystems. Thus, effects inside and outside the concerned area and its ecosystems should be determined. Each significant development project, which might change the natural environment considerably, has to submit itself to an Environmental Impact Assessment (EIA) including Strategic Environmental Assessment (SEA) and considering substantial environmental as well as social impacts.

However, study case 5 revealed that social impacts with respect to land acquisition had been the main issue of discussion during the consultation process, while the temporal scope concerning environmental impacts was limited to the period of road construction and neglected the subsequent road operation. This demonstrates that the assessment did not consider potential impacts on biological diversity, nor air pollution increases and their mitigation. Forests and trees and their respective functions for hygienic-technical support

were not even thought of. Indeed, the forestry sector is unprepared to contribute to such kind of provision and mechanism. They are just not included in the respective regulations. This also prevents the collaboration between sectors.

Principle 7- Spatial and temporal scale:

[conform: without specific hint; partly conform: case 1 (limited scope-project scale); not conform: no spatial consideration of wildlife habitats (R), case 3 and case 5]

Managing large areas like the Bengawan Solo Basin, needs institutional mechanisms to engage stakeholders across administrative borders and different levels of administration. In the case of Wonogiri Reservoir, the regional collaboration between soil and land rehabilitation unit forestry, the project consultant for the dam infrastructure of Wonogiri Reservoir, as well as with the Water Council of the respective Basin under infrastructure sector is still neglect. In this case, particularly deals against sedimentation in the reservoir (It is related with the economic issues principle 4. Assessment and monitoring efforts are identified but each unit do concern on sectoral interest / on their own program (case 1).

Indeed, ecosystem is a complex functional -spatial and temporal scale- in the administration and management of natural resources should be as much as possible considered to support development policies and its management. Therefore, such separation and division of management decisions could lift a consequence to higher unpredictable of ecosystem change and its reciprocal effects.

Considering soil and water-related protective function, optimizing land use based on area capacity and implementation of buffer-zone/green belt were being the concern. Two main degradation indicators in the study Basin have been identified, namely forest conversion to agriculture land, plantation and settlement; and the extreme water fluctuation in dry and wet seasons. Based on spatial and time-lag effect simulation, there was different capacity of lands towards land use, from capacity of lands that appropriate to land use, to lands with rehabilitation needs (case 1).

Considering conservation management for biological diversity, an ecoregion can represent each regional distribution of biome which consists of different endemism and biota. However, Forest Planning for Java (BPKH IX) does not indicate the ecoregion as a basis of delineation for conservation planning. Ecoregion and the need for its inventory have been stipulated just recently under the Law No. 32/2009 on Environmental Protection and Management.

Although conservation in Indonesia is not determined based on administrative borders, wildlife management still neglects habitat connection, for instance in Perhutani's production forests, connections of wildlife habitats are neglect in all assessed districts (case 3).

Likewise, this fragmentation is also found in the case of roads construction (case 5). It is an issue in all sectors that might be relevant to cause habitat quality.

The object of forest designation is basically determining the type of functions and defining the treatments and maintenance of those areas. Therefore boundaries for management will be defined, and connectivity between areas should be promoted where necessary. Connectivity is important to maintain interaction and integration of genes, species and ecosystems. Based on the cases above, the current forest management concerning ecological function is still limited on 'area designation' with less considering function. Focussing on this issue, designation based function should cover forest as continuum, particularly to conservation aspect.

Principle 8 - Long term management goals:

[conforms: commitment (R); partly conform: inconsistency between different laws (R); not conform: study case 2a, 2b and 5].

The management goals in the Forestry Law are determined to optimize and sustain all forest functions, including the ecological functions and considering the ecosystem approach as the strategy. This required an awareness concerning the importance of ecosystem processes and their varying temporal scales and lag effects. Important actions to follow this goal have been the development of appropriate organizational structures and the designation of main forest function areas for conservation, protection and production.

However, the comparison of regulative instruments (Chapter 4.4) revealed that one particular obstacle is the lack of consistency concerning terminologies and meanings of function categories within the Forestry Law and its regulations as well as compared to other relevant laws like the Spatial Planning Law and the Conservation of Living Resource and their Ecosystems Law (see Table 4.2 and Table 4.3). These differences lead to confusion, not only for laymen but also for staff, as could be demonstrated in study case 3 where the function of a nature reserve in Bungus remained indeterminate.

A lack of consistency or awareness and understanding of forest function categories might also have lead to the inappropriate designation and classification of Mt. Merapi and Mt. Merbabu National Parks (study case 3). In any case, it can impede appropriate management of the entire area. Furthermore, some designated nature reserves (Table 5.2) are too small in size compared to the proposed size by WCMC. The size of a conservation area is essential for the survival of the protected populations and its inadequate consideration may either indicate political counteraction or deficient management.

However, study case 5 (concerning road infrastructure development) illustrates that people tend to favor short term economic gains for the sake of environment care; trade-offs

with respect to long-term environmental goals, for instance the effects to habitat fragmentation and pollution dispersion were not considered.

To summarize: Although forestry management is formally committed to the ecosystem approach, the guidelines and mechanisms concerning other sectoral projects, do still not accommodate the ecosystem changes and their effects adequately, nor do they consider the possible benefits from inter-sectoral cooperation. Strategies and actions to protect and conserve the remnant forests are also not yet appropriate with respect to the ecosystem approach principles.

Principle 9 - Adaptive management:

[conform: without specific hint; partly conform: without specific hint; not conform: case 2a and case 2b]

Practically, adaptive management is applied in order to anticipate and cater the ecosystem changes and events; as well as to facilitate decision processes and actions such as to cope with long term changes. As shown in Figure 2.4 which illustrates the Quality Management System, changing conditions (biotic and abiotic) are usually provoked by social and ecological changes. and become objects of adaptive management. Maintaining the natural processes by focusing on which drive those changes is more reasonable to the management goal. New field information, knowledge and understanding can be used to improve the management approach in responding to the changing circumstances. In conjunction, the application of FAO's circle will generate new knowledge in onward and reduce uncertainties.

Refer to anthropocentric perspective (Chapter 2.1.3), management in practice, delivers a mandate control on ecosystems such as through arrangement of area to functions by forestry sector. Forest management has a responsible proportional on the ecosystem processes as well as their changes. Advancing scientific knowledge about ecology is important to support the management decision. Thus, respective legal instruments should accommodate the relating management to comprehend with the up-date knowledge and information.

Indonesia has ratified various international conventions and agreements relating to environmental protection. Various studies concerning biodiversity including the national study as well as the related disciplines have been reported. However, some inappropriate practices like a political claim for instance in the case of designation on Mt. Merapi and Mt. Merbabu as National Parks (case 2a), has shown that the designation is incoherent with the constructed procedures; it can lift a greater inevitable surprise that may come in the long term. According to the MoF Information Centre, such inappropriate designation is not only the case. It is

shown as well in case 2b concerning a decree on particular species protection without including protection of their habitat. Although many studies have reported that the number of population of this species in Mt. Lawu has been declined, but these do not change the management procedure relating treatment of the habitat area where is currently under water-soil-related protective function. According to forestry sector (pers-conference No. 662/II/PIK-2004), it is confirmed that some other protected areas are inappropriate on designation, and a resurvey at micro level are suggested. However, these cases have performed that forest management, in this respect, is not yet adaptive to the change e.g. actions, although the problems have been identified.

6.1.2. Area and Ecosystem Structure, Functions and Integrity Issues

Area, and ecosystem issues are dealing with precautionary approaches concerning the limit of ecosystem functioning; forest management to maintain ecosystem services and integration between conservation and use of biological diversity. Those principles require the designation of function areas with respective grading of opposed nature conservation and land use intensities, based on forestry competences and considering all types of functions, including land ownerships, utilities and development issues.

Principle 5 - Forest arrangement to maintain ecosystem services:

[conform: - ; partly conform: regulations focus more on administrative compliance (R), case 2b, case 3 and case 6; not conform: no consideration of landscape ecology (R), case 1].

Forest Management has the task to ensure sustainability of (forest) ecosystem for social, economic and environmental elements. The Forestry Law gives a mandate to optimize forest functions and maintain their sustainability. The Spatial Planning Law requires the improvement of all designated areas that constitute the Protective Sphere and uses respective area determination and allocation as the strategy to maintain those functions. Both laws have similarity concerning their main goal, namely to improve the natural environment for human well-being; but both do also give more concern to administrative compliance rather than to appropriate mechanisms to look after (forest) ecosystem functioning as such. For instance, the regulations stipulate that 30% of the juridical area or watershed should be covered by forest (Forestry and Spatial Planning Law), while the percentage of forest cover does not always reflect forest ecosystem functioning, because each area has its own characteristics and conditions. If the percentage of forest cover is lower, like on Java, it may be a useful as an easy guideline for each region to follow. On the other hand, such kind of arrangement may lead to legally confirm forest exploitation where the area is still densely forested, like in the outer Java islands.

Moreover, essential elements which may improve landscape functionality and integrity (for example corridors of natural areas like riparian areas to connect habitat patches) are barely considered in development planning (case 1 on rehabilitation; case 5 on urban and transport). In the existing spatial plan (and likewise in the agrarian law) buffer zones along rivers, lakes and seashores are rather recognized as reserve areas and need to be protected.

Also the water rehabilitation program, did not only forget about the areas in the upper Basin and their particular relevance for water-soil related protective functions; but also to integrate conservation issues like riparian habitats and their highly conservation values (case 1). These values are also not considered under forest responsibility (case 3, case 2b), apart from designated areas.

Since large areas have been urbanized in the Basin, urban forests also became very important for public welfare. They are expected to deliver various services, particularly related to health and good social relation (see Figure 2.1). Although the Urban Forest is recognized by the forestry sector and stipulated under the respective regulation, this does not include all relevant functions, for example protection against undesirable views, noise, heat-radiation, pollution mitigation or water interception to mitigate flooding (see case 5 and 6).

Finally, the entire area of the Bengawan Solo River Basin becomes accessible since the development of road infrastructure tends to open most remote areas, disregarding ecosystem services (case 5).

Principle 6 - Precautionary approach to maintain ecosystem functioning:

[conform: decree for conservation areas (R) case 1; partly conform: decrees without consideration of habitat requirements for survival (case 2 and decrees in Table 5.2); not conform: without specific hint.

Precaution is required in the light of insufficient understanding of nature's complexity, like for example precise ecosystem capacity limits with respect to the disturbances. Implementing adaptive management is part of such precautionary approach.

Apart from this, some more explicit segregated precautionary efforts have been implemented in forest management, for instance the legal provisions that require the designation of conservation areas by decrees. It is an important legal measure against any kind of violation of forest areas. However, there are practical examples, like cases 2a and 2b, which are incoherent with the required designation procedure or with single species habitat requirements and may lead to inappropriate management measures Another kind of

inappropriate designation concerns the insufficient size of conservation areas compared to the proposed size.

Various studies related to biodiversity have also been conducted by the Ministry of Environment, and suggestions have been given including the forestry sector. Although such attempts to reduce uncertainties about the dynamic and complex nature of ecosystems may not yet provide perfect understanding, they are essential for adaptive management which includes active learning from monitoring outcomes to determine appropriate management measures more accurately. With respect to preservative management of watershed, hydrology and environmental geology, monitoring and modeling to estimate water-soil input and output in the study area as well as to determine the driving forces behind has been implemented (case 1). The main outcome is information about land use capacities and a list of priority areas which need to be rehabilitated. However, rehabilitation measures will need cooperation and integration involving other sectors and their impacts on land use change, such as land conversion into roads and settlements.

Principle 10 - Zonation and multifunctionality of forests:

[conform: case 4; partly conform: case 6; not conform: no integrated conservation objective (R), case 2b and case 3]

In Java, multifunctionality of forests can be found within traditional agriculture practices like agroforestry, community forest / tree garden, mixed garden and home garden. Out of which only agro forestry and tree garden are formally recognized by forest management. On the other hand, the current strategy with respect to biological diversity exclusively related to designated protected areas. However, the challenge to protect an area increases with growing population density. Forest encroachments and pressure on land lead to permanent reduction in area size, fragmentation and loss of connectivity of the remaining natural forest patches. Most areas are getting more and more urbanized, and the need for land with good environmental quality and capacity to provide desirable services has become a big challenge. Nonetheless, the potentially supporting role of forest management in this respect is still neglected, particularly concerning mixed garden and home garden. This is also demonstrated by the lack of respective offers.

Furthermore, a shift to more flexible approaches to integrate conservation measures is needed. This was demonstrated using the example of the protected, species *Presbitys comata* and its endangered population caused by habitat degradation on Mt. Lawu. The designated water-soil protection function did not lead to appropriate managed for the species survival, neither in the actual habitat area nor in the buffer zone (case 2). Likewise, the case of wildlife management under Teak production stands, where Perhutani did not manage to

deliver appropriate conservation objectives and integrate nature conservation issues into forestry management (case 3).

Considering urban area, the Surakarta city has improved their numbers of green space areas. The target is to designate and manage 30% of the total urban area as green space area, as required by law. However, multifunctionality of Urban Forests still needs to be optimized.

6.1.3. Stakeholder and Economic Issues

Stakeholders and economy issues are related to the needs for relevant information and transparency with respect to capacity building and participation. Participation is democracy is supposed to support people to get what they really need or want (societal choice) in the case of forestry. Economic instruments like incentives, disincentives and internalization of environmental costs and benefits can be applied to develop accountability of ecosystem services as well as appropriate schemes for local community benefits.

The forest administration has to provide relevant information and ensure transparency as basis for consolidated decision making. It also has to support capacity building for better communication and collaboration with communities, other sectors and local governments. All these aspects can help to improve the quality of management and to support societal choices concerning nature and the environment. In this respect the forest administration should also be capable to design the integration of conservation and use functions for local communities' benefits. Forest policy should consider providing economic instruments as well as qualified information for best decision.

Principle 1 - Societal choice as a result of democratization processes:

[conform: case 4; partly conform: without specific hint; not conform: case 2a]

High population density and land scarcity for agriculture have often created conflicts between communities and the forestry administration. However, the developed social forestry and community forest schemes do give examples of good cooperation and collaboration: (case 4). Since an Integrated Community Forest Development Program *(PMDHT)* has been introduced under Perhutani, farmers have to form groups to maintain the communication collectively, resolve conflicts and maintain the cooperation with Perhutani. This transition from former individual to group relations has strengthened the bargaining position of farmers and gives them a stronger 'voice' to call for their needs. The particular goal of PMDHT is to allow farmers to have a long term stake in the economic future of the plantation. Hence, they are also involved in issues like tree species selection. All in all, Perhutani has improved the implementation of social forestry considerably.

Community forestry (on private land), has improved as well. Multi-stakeholders participation is clearly demonstrated and the regulations provide appropriate schemes and mechanisms, in which the roles and relations between land owners, the government and the business sector are clearly outlined (case 4).

However, the case of conservation areas designation on Mt. Merapi and Mt. Merbabu (case 2a) is different. In the process of designation, some required steps of decision making were skipped, for instance: not all interested parties have been invited, no clear information was given, particularly not to the local communities in and around the area; there was no equality of status nor capacity of the local people to be effectively involved; finally the decrees were issued all of a sudden, although the consultation process was not yet finished.

Principle 4 - Incentive, disincentive and internalization environmental cost and benefits:

[conform: without specific hint; partly conform: incentive (not recognize disincentive and internalization cost and benefits) (R) ; not conform: case 5, case 6]

The Spatial Planning Law indicates incentive and disincentive mechanisms concerning compensation of impacts of development in rural and urban areas; while the Forestry Law allows for incentives or compensation for private forest holders.

Considering watershed management, the upper basin has been targeted for reforestation. Soil preservation measures in the upper Basin have been recognized as an important effort to reduce sedimentation and flooding in the lower areas. Various options of incentive schemes directed at community-forestry have been institutionalized. These community forest schemes have been designed for land owners where their land carries 'social obligations' and has to be maintained as forest, such as for watershed protection (case 4). Since decentralization has been implemented, incentive and disincentive mechanisms have been an issue regarding compensation for the upper Basin land owners where their large areas are used for protection functions. However, developing schemes for valuing such ecosystem services still faces constraints due to inadequate legal provisions to accommodate them which are why they are not yet established.

Concerning urban areas, it is difficult to find a representative Urban Forest in Surakarta city. Some old-growth trees (e.g. *Ficus benjamina*) are found just in tiny rugs (2-4 old trees growing together) around and within a palace ('*kraton*') of the former Surakarta-Kingdom. Such big trees with wide-crowns are an effective shelter for people from heat-radiation which they preferably use for their daily activities. Unfortunately, only few old growth trees are remaining and believed to be sacred trees. Generally, the quality of life in Kota Surakarta is decreasing due to air pollution and heat-radiation as indicated in the Regional Plan of

Surakarta (1993-2013). Previously, environmental quality was not seen as an 'investment' but rather as a 'burden' whiles the lack of budget aggravated the situation. However, such environmental benefits and costs from green space areas like Urban Forests need to be internalized, including incentives for private lands that are designated to be used as common goods (case 6).

In the road's construction project (case 5), a clear attempt for public consultation under the Environmental Impact Assessment Scheme could be recognized. However this was restricted to the scope of social, or rather individual economic impacts from land allocation and possible environmental impacts during road construction. Operation impacts after the roads construction phase were not included in the plan.

Principle 10 - (Forest) ecosystem benefits for local communities:

[conform: case 1, case 3, case 4 and case 6; partly conform: without specific hint; not conform: without specific hint;]

Biological diversity conservation practice in Indonesia is still an issue of 'protected' or 'non-protected' areas, although it has long been realized that it is necessary to dismiss this mutually exclusive, bipolar approach and shift towards a continuous and more flexible concept, from strictly protected to human-made ecosystems, where conservation and land use are integrated. The challenge of conservation and environmental management objectives is to consider the local communities' needs without impairing the quality of the natural environment further. This also involves the conservation and management of forests. Their multiple services or benefits could be highlighted in stud they cases, namely: Efforts to preserve the forest cover and soil layer, particularly in the upper Basin, to sustain water supply and reduce sedimentation (case 1), while the respective forest ecosystems provide additional food for the local communities: commonly hunted are *kijang* (deer) and *celeng* (wild pig) (case 3); Extra harvest for farmers from tree crop plants within agricultural areas (although the forestry sector does not formally determine forest benefits in cultural landscapes; case 4); Various functions of green space areas, like fresh air, shade during hot sunny days as well as space for social interactions for city dwellers (while biological diversity is not yet explicitly integrated in Urban Forest establishment; case 6).

Principle 11 – Information and transparency as a basis for capacity building and explicitness of participation:

[conform: the needs to consider all information (R), case 4; partly conform: without specific hint; not conform: case 2a] .

Both, the Spatial Planning Law and the Forestry Law indicate the needs to consider all relevant information for planning to determine area allocation and functions. However, the

current practices have been often affected by top down political claim. As reported, the designation of the Mount Merapi and Mount Merbabu National Parks (case 2) is a (forestry) sector's outcome with rather limited stakeholder participation. The required qualifications for the designation of National Parks are not fulfilled while the local social conditions are inappropriate. Probably, the area will never be approved as a National Park according to the IUCN standards.

On the other hand, Perhutani also presents improvements in practicing participation in social forestry (case 4). Participation is shown also on the road infrastructure projects. However, a narrow scope in EIA to land acquisition and environmental impacts only during the project run does not give any advantages for the nature environment. In this case, a proper mechanism relating to the local governments is needed in the term of community consultation, especially at any preparation stage of development projects (case 5).

Principle 12 - communication and collaboration at all level and relevant stakeholders:

[conform: participation and collaboration (R); partly conform: without specific hint; not conform: case 1, case 3 and case 5]

The Forestry Law indicates the importance of participation and coordination of all stakeholders in community and in forest development, while the Regional Autonomy Law indicates the necessity to involve educators, farmers, and ordinary people in the development process. The existing structured organization of the forestry administration and the regional communication, coordination and collaboration between institutions are supposed to work effectively.

However, several case studies (1; 3; 5) revealed that respective mechanisms and collaboration within the forestry sector, as well as between forestry and other development sectors have been disregarded, namely: between the forestry unit for watershed (BPDAS, Ministry of Forestry) and the Wonogiri Reservoir Project (CDMP Project under Ministry of Settlement and Infrastructure) concerning sedimentation (case 1); between Perhutani and the Nature Conservation Agency (BKSDA) concerning conservation issues in the case of endangered species *P. comata* (case 3); and between the Forestry sector and the Department for Settlement and Infrastructure concerning trees/forest establishment related to roads development (case 5).

In so far, appropriate institutional arrangements for coordination and cooperation between the forest authorities and all other possibly concerned authorities in landscape use and development seem to be the key issue to ensure the implementation of the required ecosystem approach.

Table 6.1 below summarizes and presents all identified aspects with respect to their conformity with the EsA principles for forest arrangement. It illustrates that large effort has been put into appropriate regulations but that the need for action still remains. Meanwhile, the study cases demonstrate rather limited implementation and still many options for improvement. This will be the issue of the following section.

Table 6.1. Number of aspects identified which conform to its EsA Principles in Forest Arrangement

No	Principles in the CBD's Ecosystem Approach	conform		partly conform		don't conform	
Adaptive Management Issues							
1	Laws and Regulations	-	-	R	-	-	-
2	Structural organization to the lowest appropriate level	R	-	-	-	-	-
3	Environmental Impact Assessment	R	-	-	5	R	-
7	Spatial and temporal scales	-	-	-	1	R	3 / 5
8	Long term management goals	R	-	R	-	-	2a 2b
9	Adaptive management	-	-	-	-	2a 2b	2a 2b
Area and Ecosystem Structure, Functions and Integrity Issues							
5	Forest arrangement to maintain ecosystem services	-	-	R	2b 3 / 6	R	1
6	Precautionary approach to maintain ecosystem functioning	R	1	R	2a 2b	-	-
10	Zonation and multi-functionality of forests	R	-	R	6	R	2 / 3
Stakeholders and Economic Issues							
1	Societal choice and democratization	-	4	-	-	-	2a
4	Incentive, disincentive mechanisms and internalization of environmental cost and benefits	-	-	R	-	-	5 / 6
10	Forests benefits for local communities	-	1 / 3 4 / 6	-	-	-	-
11	Information and transparency as basis for capacity building and explicitness of participation	R	4	-	-	-	2
12	Communication and collaboration at all level and relevant stakeholders	R	-	-	-	-	1 / 3 5

Note: R= respective Regulations; 1-6 = number of presented case study in chapter 5.2.1 – 5.2.6.

6.2. Strenghts, Weaknesses, Opportunities, and Threats Concerning the Ecosystem Approach Application in the Bengawan Solo Basin

The application of EsA Principles in Indonesian forestry does show some strengths but still faces huge weaknesses and threats. However, it may also take advantage of some opportunities.

The Strengths, Weaknesses, Opportunities, and Threats (SWOT) framework, is supposed to help formulate better management strategies and implement an optimal and effective management system.

The following Table 6.2 indicates some of these internal strengths and weaknesses, as well as external opportunities, and threats concerning the application of EsA Principles in the case of the study area Bengawan Solo River Basin.

Table 6.2. SWOT Analysis of EsA Principles on Ecological Forest Functions Arrangement in the BS Basin

STRENGTHS • Commitment /statement from the forestry sector to apply the ecosystem approach • Management commitment on forest arrangement to optimize functions • Organization structure down to the lowest appropriate level • Established reforestation programs • Strengthening of local participation processes related to forests • Established incentive mechanisms • Good traditional agro-forestry practices	**WEAKNESSES** • Inconsistent and inadequate set of regulations • Inappropriate designation of conservation areas • Sector oriented, narrow project scope • weak communication and cooperation • Lack of adaptive management • Lack of integrated, conservation strategy (protected' and 'non protected'), disregarding the landscape scale • Uniformity of forest management by Perhutani, without consideration of local variability • Limited forestry provision and competence outside designated forest areas • lack of disincentive mechanisms and internalization of environmental costs and benefits • Only small natural forest patches left, connectivity lost.
OPPORTUNITIES • Law No. 5/1990 on Conservation of Living Resource and their Ecosystem and Law No.5/1990 on CBD Ratification; • The call to optimize the environmental, social and economic benefits for the local community by Law No. 41/1999 on Forestry. • The call for ecoregions as basis for environmental management plan by the Law No. 32/2009 on Environmental Protection and Management and IBSAB (Indonesia Biodiversity Strategy and Action Plan). • The call for 30% forest cover by the Law No. 26/2007 on Spatial Planning (30% forest cover watershed or city) and Law No. 41/1999 on Forestry (30% forest cover watershed or island). • the call for reforestation / rehabilitation by the Law No. 41/1999 on Forestry • the call for integration management for all kind of development issues to aim sustainability by the Law on Spatial Planning; Law on Forestry; Law on Environmental Protection and Management; and IBSAB (Indonesia Biodiversity Strategy and Action Plan) • the call for inter-sectoral collaboration related to EIA by Law No. 32/2009 on Environmental Protection and Management and Law No 22/1999 on Regional Government implies extended responsibility of the forestry sector	**THREATS** • Only small natural forest patches left, connectivity lost, • Increasing population density might lead to further urbanization, forest loss and landscape degradation • Large area is owned by private ownership (high compensation cost) • Sector centric policies and perspectives compromise coordination, cooperation and consideration of forest functions

Strengths

The endorsed commitment to apply the ecosystem approach is a supportive forestry policy and a new directive for forestry development; as well as the commitment of the forest management to optimize the environmental, social and economic benefits for the local community.

The established management indicates that the organization structure in the forestry sector encompasses the lowest necessary level and it can be expected to be more effective in implementing the forest management concerning ecological function in particular. Together with this, under democracy system, decentralization system can help effectively to identify local needs and solve problems through participation, as well as to develop local identities and to shorten the decision making process.

The established social forestry under Perhutani and the developed incentive mechanism scheme for community forest demonstrate active participations from stakeholders in forestry issues. In addition, some good agro-forestry practices have been recognized, although not all those practices have an adequate provision/support yet from the forestry sector. The role of these agro-forestry practices is important particularly in Java, where is dominated with agricultural land use. They are not only meaningful in economic aspects but also deliver ecological benefits, for instance due to non-monoculture production system, high species diversity and multi-storied configuration.

Weaknesses

The study also demonstrates weaknesses in the forest management system, including inconsistency and inadequacy of regulations and the absence of some technical guidelines. Some regulations still reflect strict sectoral and internal orientation which restrains intersectoral collaboration. Further, management practices are still not adaptive.

Uniform procedures and goals demonstrate the lack of considering and valuing local variability, including biological diversity. Coupled with inappropriate designation of area functions, this will surely lead to further biodiversity losses. The lack of holistic understanding and consideration of landscape ecology is demonstrated by the ignorance of habitat connectivity and up-to-date wildlife conservation strategies. On top of that, the Indonesian conservation strategy still relies on segregation, focussing on designated protected areas while disregarding conservation values outside protected areas. Respective forestry competences and provisions are missing, including disincentive economic mechanisms which might foster unsustainable development.

Opportunities

The CBD ratification and the Law on Conservation of Living Resource and their Ecosystem are umbrella policies for all development sectors to conserve and maintain the ecosystem functioning and biodiversity, including forests. Thus, it implicates intersectoral related to EIA and extended responsibility of the forestry sector to maintain all types of forest ecosystems as well as to attach conservation goals in all forest functions.

The Forestry Law, the Spatial Planning Law as well as IBSAB recognize the different spheres categories that should be protected. They provide opportunities for the forestry sector to preserve and maintain those areas. In addition, ecoregion as a unit basis for inventarization that is promoted by IBSAB and the Law on Environmental Protection and Management can be implemented to recognize local variability of regions like the common environmental conditions, species, and disturbance processes. This can also extend the current role of foresters to areas outside designated forests. These opportunities will afford advantages but do require change of the management objective that covering whole terrestrial area into integrated landscape ecology.

With the forest management system and well prepared guidelines in place, this will open new opportunities to communicate, cooperate and collaborate with other development sectors and local government.

Threats

The high population density has changed the natural landscape of the study area. The increasing demand of land for settlement, infrastructure and cropping lands leads to further remnant forest losses and fragmentation and it affects the ecological functionality and integrity of the entire landscape with respect to air, water, soil and natural habitats with their specific biodiversity. The trend of land use change towards a more artificial and ‘’un-ecological’’ state is obvious. The loss of large forest habitat areas, forest fragmentation and isolation as well as the inadequate designation of protected areas will determine the future survival of meta-populations and ecosystem resilience. In addition, large area owned by private like in Java can be very costly such as for compensation.

Sector centric policies usually lead to conflicts at lower level, and they give adversely impacts to the environment. Furthermore, sector centric policies do often restrict cooperation and collaboration with other sectors due to limited on provision as such including for external awareness.

6.3. Answers to the Research Questions

Question 1: What is the substantial content of laws concerning ecological functions of forests and area management in Indonesia; and what are the implications of those laws concerning the study area?

The Forestry Law, the Spatial Planning Law, the Environmental Protection and Management, and the Conservation of Living Resource and their Ecosystem Law are expected a set of regulations that determine ecosystem structure, functions and integrity in Indonesia. All these laws have a similar commitment on to maintain and sustain the environment; however, there are some inconsistencies in terminology and classification of area (forest) functions.

For quite a number of issues and principles conformity between the Forestry Law and the Ecosystem Approach principles could be identified, as presented in Table 6.1. However, the forestry regulations also do still cover a number of weak points, concerning: a) The lack of some necessary provisions/mechanisms, particularly regarding adaptive management and ecosystem structure, functions and integrity issues; b) The Law is still a sectoral centric, emphasizing more on administrative compliance and a conservation strategy which is limited to protected areas; c) Disincentive mechanisms and internalization of environmental costs and benefits are not yet included.

The respective implications in the study area are: a) A lack of collaboration between forestry subdivisions and between sectors, for instance between production forest and conservation (case 3), forestry and infrastructure sector (case 5), forestry and city council (case 6), and forestry and agricultural areas (case 1); b) Appropriate representative units for forest management until lowest necessary level like Nature Conservation Agency at each province level (BKSDA) and Watershed Agency (BPDAS); c) Lack of integrated landscape ecology, inappropriate interventions related to wildlife management under production function (case 3) and protective forests functions (case 2b); d) Cooperation between farmers and Perhutani (case 4); e) Incentive schemes for private forest owners e.g. community-forest (case 4) and urban forest (case 6), but no disincentive scheme from benefiting to supporting areas of forest functions (case 5) , and no internalization of environmental costs and benefits in urban areas (case 6).

Question 2: What responsibilities have been taken by the forestry sector to improve ecological functions of forests concerning the site of study?

Applied to forest management, the EsA principles call for the responsibilities and strategy which should be followed to provide integrated management of land, water and living forest resources and promote conservation and sustainable use. Referring to the Table 6.1 the forestry sector has taken a wide range of responsibilities for forest functions and has specified adequate measures to improve them. However, a greater number of 14 issues related to the principles 1, 2, 3, 6, 8, 10, 11 and 12 was found to just 'partly conform', since the respective principles and values in the forest management system are still not fully established; finally another 14 issues concerning principles 1, 3, 4, 5, 6, 7, and 10 were found 'not to conform'; demonstrating that the forestry sector still misses considerations to the related principles, namely principle 1, 3, 4, 5, 7, 8, 9, 10, 11 and 12.

Issues mentioned as 'conform' and 'partly conform' to the EsA principles, were mostly related to administrative compliances, for instance designation and management representative to the lowest necessary level; while 'not conform' matters were related to biological diversity conservation, adaptive management as well as integrated conservation strategy and its implementation.

Question 3: What consequences will be taken if EsA principles will be applied by the forestry sector including collaboration with other development sectors and local communities?

To aim at sustainability of ecological functions, the full set of EsA principles should be considered. The respective EsA principles in column 'partly conform' and 'not conform' should become the first matters for review and revise of the current inappropriate policies and integrate those in the management system.

The biggest challenge is to implement the ecosystem approach in areas where no larger natural forest patches are left and connectivity has been lost due to high population density. High proportion of right-land ownership as well as development policies that are still sector oriented or limited to economic interests do hamper this implementation further .

Concerning collaboration with other development sectors, the internal challenge for the forestry sector is to prepare a set of adequate provisions for all other types of ecosystems to be enriched by forests and their possible forest functions as an alternative; and to develop all possible forms of cooperation and collaboration with other sectors to support integrated management.

Regarding sectoral development and economic interests, a full economic valuation of forest ecosystem services should be developed in order to create adequate incentive-disincentive mechanisms and promote internalization of environmental costs and benefits.

Question 4: How EsA will preserve the quality of existing forests, preserve biodiversity, enhance the forest landscape, and improve the environment quality for human well being?

The SWOT Analysis Table 6.2 can be used to develop scenarios: The existing elements which are the strengths of the forestry sector must be maintained and improved for example commitment to apply ecosystem approach, established organization structure until to lowest necessary level, reforestation programs, involving local people and established incentive mechanisms. The current existing values supporting the environment should be maintained as well such as the good traditional agro-forestry practices.

Opportunities for improvements can be acquired from the related existing laws/guidance, for example Forestry Law, Spatial Planning Law, Environmental Protection and Management Law and IBSAB (Indonesia Biodiversity Strategy and Action Plan), and Regional Government Law. The laws call for sustainability, a better environment management planning (ecoregion as a basis for inventarization), a minimum forest cover, reforestation and integrated management for all kind of development issues. Therefore intersectoral collaboration is more visible. It implies extended responsibility of the forestry sector.

However, forestry sector still faces some internal constrains, for example inconsistency and inadequate set of regulations, sector oriented, incompetence in outside designated areas, lack of adaptive management, inappropriate conservation strategy - disregarding landscape scale, less consider local variability and avert disincentive mechanisms and internalization of environmental costs and benefits.

The great challenge for the forestry sector deals with the only small natural forest patches left with connectivity lost, the increasing population density might lead to further land use changing to non forest, landscape degradation and (other) sector centric policies. Large area is owned by private. It can be meant high compensation/incentive cost. So far, disincentive mechanisms and internalization of environmental costs and benefits are not taken into account, it can cause an ineffectiveness of environment programs including forestry programs.

7. Final Conclusions and Recommendations

7.1. Conclusions

The study shows that the Indonesian policy and management in forestry towards an ecosystem approach does not yet fully coincide with the suggested principles. This is not only demonstrated by the set of respective Indonesian regulatory instruments but also by the study cases that have been conducted (see chapter 6.1), and is still inadequate to comprehensively support the forest management to ecosystem approach (see Table 6.1). The most important findings are related to adaptive management, to the concept of integrated landscape ecology and to insufficient economic mechanisms.

The current Forestry Law, the Spatial Planning Law, the Environmental Protection and Management Law, the Conservation of Living Resource and their Ecosystem Law should be expected a set of regulations that can conserve ecosystem structure, functions and integrity in Indonesia. Unfortunately, there is found some unsynchronuous and inconsistencies between the laws for example on functions classification.

The current forestry regulations and management do still sector centric and focus on administrative rules. The conservation strategy is still limited on 'protected' areas neglects 'non' protected areas, such as cultural landscapes or urban areas. This has become a very important issue since the study area, likewise all Java, is dominated by private agriculture land (> 70%), while just 18% is covered by forest, and only tiny remnant forests are left and designated as conservation areas (less than1%).

Although the organization structure of the forestry administration is developed appropriately to the lowest necessary level, the inadequacy of forestry's provisions and guidance to follow conservation goals as well as the lack of appropriate mechanisms, constrain the cooperation and collaboration between subdivisions within forestry sector, as well as between forestry and other development sectors or the local government. Furthermore, forestry management is still not adaptive to ecosystem changes. At the same time, adjustments of wrong decisions have not been made although for example many designations of protected areas have been identified as inappropriate.

The Indonesian forest management is limited to designated forests, namely: production forests, protective forests and conservation forests. Participation is particularly realized in production and protective forests, respectively under the social forestry and community forestry scheme. The community forest programme offers incentive schemes and cooperation between government sectors, business sectors and farmers who are the private land owners. Beside economic incentive mechanisms, two other economic mechanisms are

considered by the Environmental Protection and Management Law, namely: disincentives and internalization of environmental costs and benefits, but the Forestry Law does not recognize them.

To conclude, there is still a great challenge for the Indonesian forestry sector to perform management according to the ecosystem approach principles. The big challenge is given at the implementation level because there are no large patches of natural forest left and their connectivity got lost due to the high population density, the large extend of private-owned land, and the policies that are still sectoral-centric, rather than inter-sectoral.

7.2. Recommendations

1) The set of related laws and regulations as well as the commitments of the forestry sector are obviously the foundations to further develop an appropriate management system. However, synchronization and inconsistencies of all supporting laws and guidance, namely the Forestry Law, the Spatial Planning Law, the Conservation of Living Resource and their Ecosystem Law, the Environmental Protection and Management Law and the IBSAB (Indonesia Biodiversity Strategy and Action Plan) and the Regional Government Law should be resolved to support intersectoral collaboration. For forestry sector, it implies extended responsibility.

2) The nature conservation subdivision and particularly the Nature Conservation Agencies should be encouraged and supported to explore, monitor and assess their regions (province) on the landscape scale and based on a holistic landscape ecology approach where forests are essential constituent parts. Ecoregion as a basis for inventarization have been acted in the Environmental Protection and Management Law. Strategy and action plan for each development sectors have been initiated by the IBSAB (Indonesia Biodiversity Strategy and Action Plan). The collected information and data should be used for forestry planning; in particular for redesigning the forest functions plan with respect to landscape functions that need to be improved and where forests could be the best alternative. This ecology data should be periodically updated as basis for management policy or actions (temporal scale).

3) In Java, only small natural forest patches left and the connectivity lost. Particularly in the study Basin, most conservation areas which do not conform to the required criteria should be redesignated. Furthermore wide designated forest function is for production and protective functions; conservation goals should be promoted in these functions to increase habitats' connectivity. Whilst, sectoral programs should be integrated and put ecosystem processes and functioning as also important goals of management. To support the effectiveness, economy instruments should be applied.

4) Large area in Java is owned by private. It is the greatest challenge to implement the conservation goals. A better conservation strategy for integrated conservation and wildlife management should be developed for the area outside 'conservation/protected areas'; conservation goals for all types of ecosystems, land uses and land ownership or cover the whole terrestrial area. The laws should also determine the obligations and rights of the people, therein the economic instruments (incentive, disincentive and internalization of environmental costs and benefits) can be introduced; and a mutual people participatory can be better planned.
5) In addition, the influence of ecosystem services (see Figure 2.1) or various benefits of forest ecosystems on human well being can be better performed.

The forestry sector should also strengthen cooperation and collaboration within the organization, with other development sectors, as well as with regencies/cities and local communities to better follow conservation goals, and environmental improvement for human well-being. This involves:

1) Cooperation between subsidiaries within the forestry sector, for instance between the respective nature conservation agency at province level and: a) The watershed management unit, concerning species selection for rehabilitation/reforestation of certain areas where habitat conservation is a target; b) Perhutani at district level, concerning habitat connections for wildlife in production forests, as well as protective forests and 'other purposes' forests, including riparian areas.
2) Cooperation between the forestry sector and other development sectors or local governments, for instance: a) In the scope of Environmental Impact Assessment, where the forestry sector should be involved from the beginning of the project, particularly with respect to budgeting, space allocation and technical considerations regarding forest (and tree) functions.; b) In agricultural areas where forest-crop plants should be chosen which support corridor and migrating area functions for wildlife as well other ecologically functions in agriculture areas.
3) Cooperation between the forestry sector and private land owners, where good traditional agriculture practices like home garden, mixed garden and tree garden should be promoted. Regarding economic mechanisms, and besides existing incentive mechanisms, the forestry sector should introduce disincentive mechanisms, in order to discourage un-ecological practices over lands/resources including private lands. A further important mechanism that needs to be developed, concerns the internalization of environmental costs and benefits

Finally, the current competences of foresters should be improved and extended

Recommendations for further studies include: 1) researches concerning adaptive management in the forestry sector; 2) integrated landscape ecology, particularly in 'non' protected areas and cultural landscapes; 3) assessment and valuation approaches for forest ecosystem services; 4) 'ecosystem services' in Indonesia. Further studies concerning other institutions that deal with the management of natural resources and biodiversity, like the Ministry of Agriculture, local governments, etc. could be added. Even institutions that are not directly related to forestry, like the Ministry of Energy and Mineral Resources, the National Development Planning Agency etc., could be included with respect to relevant environmental impacts of their activities.

Summary

Signing and ratification of the Convention on Biological Diversity (UN-CBD) and its adoption into National Law have also affected the Indonesian Forestry sector. The Ministry of Forestry has gradually changed its policy from pure timber extraction to the globally required, so called ecosystem approach. This is to be seen as “a strategy for integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way” (www.cbd.int/ecosystem/). Accordingly, the current Law on Forestry No. 41/1999 enforces forest development and management through forest functions designation.

Landscape ecology and context are the key issues which have to be considered in this respect. The forest administration in Indonesia shall not focus exclusively on isolated forest areas but involve the entire landscape with respect to all possible functions of forests. Likewise, the ecosystem approach requires a transformation from the traditional concept of segregated conservation in protected areas which disregards non-protected areas to integrated conservation measures in all type of land uses and from a sectoral approach to inter-sectoral collaboration.

Consequently, forest management based on the ecosystem approach requires foresters’ competences with respect to all types of ecosystems. Thus, the array of responsibilities covers natural, rural, as well as urban areas. Integrated conservation and environmental protection relying on forest functions have to be coordinated with other sectors of development and need cooperation with any kind of land-ownership. These are the new challenges for the forestry sector and the foresters.

This study does not only discuss how the ecosystem approach is interpreted and implemented by Indonesian Forest policy and administration. It also discusses how the UN-CBD’s ecosystem approach principles allow guiding forest development and cooperation in a broadened environmental context.

The objectives of the study are as follows:

1) to study some cases from the forestry sector development’s policies and practices in Indonesia, focussing on ecological forest functions in the landscape context.
2) to evaluate the EsA principles as a concept that promotes conservation of biological diversity of forest ecosystems and the adjacent landscape;
3) to evaluate the meaning and consistency of the current forest function arrangement under respective Indonesian laws, as well as some examples of implementation in recent project development;

4) to identify the obstacles and opportunities for Indonesia's current forest function management

5) to name the challenges and necessities and give recommendations for further forest management improvement

The research approach includes both, desk and field case studies concerning the role and the inter-sector cooperation of the forest administration in the context of various development projects in the Solo River Basin / Java. The desk study has been conducted by reviewing respective literatures and reports and by exploring the legal basis of Indonesian forest function arrangement following the hierarchy of legislations and spatial responsibilities and looking at the relations and consistencies between them. The field work was carried out by visiting the case study areas, conducting key person interviews and collecting secondary data. Consequently, every study case area was visited several times which helped to get familiar with the specific situation and develop an own picture

The analysis is structured into three main aspects, namely adaptive management issues; area and ecosystem structure, functions and integrity issues; and stakeholders and economic issues.

The first part focuses on adaptive management issues, particularly related to organization and adaptive management. The results of the study show that the Indonesian forestry sector structurally has expanded its representation to the local level. However the guidelines provisions and mechanisms that have been provided so far, cannot assure biological diversity conservation and environmental protection. The current forestry provisions cannot cope with the rapid deforestation and urbanisation processes because they are restricted to designated forest areas.

The second part is related to area and ecosystem structure, functions and integrity issues. All study cases show that indispensable principles for nature protection, like large representative areas, riparian areas, habitat connectivity, and integrated conservation objectives outside protected areas (in agricultural and urban areas) have failed in getting attention and support from the forestry sector at any level of management.

The third part of the analysis focuses on stakeholders and economic issues. The results reveal that participation in the forestry sector is realized particularly in production and protective forests, namely under the social forestry and the community forestry scheme, including the cooperation between government sectors, business sectors and farmers. Focusing on economic instruments, the forestry sector recognizes only incentive mechanism; disincentive mechanisms and internalization of environmental costs and benefits which are enforced by the Environmental Protection and Management Law are not yet included.

All in all the current forest management in Indonesia is still showing significant unconformity with a number of EsA principles, although policies and regulations have been improved significantly, providing fundamental preconditions for the realization of the ecosystem approach in forest management.

Zusammenfassung

Die Unterzeichnung und Ratifizierung des Übereinkommens über die biologische Vielfalt (Convention on Biological Diversity, CBD), auch als Biodiversitätskonvention bekannt, betreffen auch den Indonesischen Forstwirtschaftsektor. Das Forstwirtschaftsministerium hat allmählich den Fokus seiner Politik von der reinen Holzproduktion auf den international geforderten, sogenannten ökosystemaren Ansatz verlagert, der eine Strategie für das integrierte Management von Land, Wasser und biotischen Ressourcen umschreibt, die Schutz und nachhaltige Nutzung gleichermaßen vorantreibt (siehe www.cbd.int/ecosystem/). Das aktuelle Forst- bzw. Waldgesetz Nr. 41/1999 betont dementsprechend die Bedeutung der verschiedenen Waldfunktionen im Rahmen der forstlichen Bewirtschaftung und hat die betreffenden Manageprinzipien anerkannt.

In diesem Zusammenhang sollten landschaftlicher Kontext und Landschaftsökologie als Schlüsselbegriffe genannt werden. Der Forstwirtschaftssektor bzw. die staatliche Forstverwaltung in Indonesien soll nicht länger einzelne Waldgebiete isoliert betrachten, sondern die gesamte Landschaft mit Blick auf die Bedeutung der Wälder und ihre möglichen Funktionen im Auge behalten. Gleichermaßen fordert der ökosystemare Ansatz (*ecosystem approach*) eine Verlagerung vom traditionellen und segregativen Schutz(gebiets)gedanken, welcher ungeschützte Bereiche ignoriert, zu einer ganzheitlichen Bewahrung natürlicher Ressourcen im landschaftlichen Kontext, was die Berücksichtigung aller Landnutzungstypen und eine intersektorale Zusammenarbeit erfordert.

Dementsprechend erfordert das Forstmanagement forstliche Kompetenz mit Blick auf alle Arten von Ökosystemen. Die forstliche Verantwortung erstreckt sich von Naturlandschaften über ländliche bis hin zu urbanen Gebieten. Integrierter Natur- und Umweltschutz auf der Grundlage der Waldfunktionen erfordert auch die Koordination mit anderen Sektoren der räumlichen Entwicklung und die Zusammenarbeit mit den Landbesitzern. Dieses sind die neuen Herausforderungen für den Forstwirtschaftssektor und für die Förster.

Diese Studie zeigt nicht nur, wie der ökosystemare Ansatz seitens der Indonesischen Forstpolitik und Forstverwaltung interpretiert und implementiert wird. Sie befasst sich auch damit, wie die in diesem Rahmen proklamierten Prinzipien als Leitfaden für die Forstentwicklung und die forstliche Zusammenarbeit in einem weiter gefassten ökologischen Kontext dienen können.

Die Ziele der Studie sind folgende:

1) Fallbeispiele der indonesischen forstlichen Planungspraxis im Hinblick auf ökologische Waldfunktionen in ihrem landschaftlichen Kontext zu analysieren,

2) die Grundsätze des ökosystemaren Ansatzes als ein Konzept zu Schutz und Förderung der Biodiversität im landschaftlichen Kontext auszuloten,

3) die inhaltliche Bedeutung und Konsistenz der gegenwärtigen Waldfunktionenzuweisung in den dafür relevanten Indonesischen Gesetzen sowie deren Umsetzung in neueren Entwicklungsvorhaben zu prüfen,

4) die Hindernisse und Chancen in Indonesien zu identifizieren,

5) die Herausforderungen und Erfordernisse sowie Empfehlungen für die künftige Verbesserung des forstlichen Managements zu benennen.

Der Forschungsansatz beruht auf dem Studium schriftlicher Quellen und auf örtliche Fallstudien zur Rolle der Forstverwaltung und ihrer Sektor-übergreifenden Kooperationen im Rahmen forstlicher und anderer Entwicklungsvorhaben im Einzugsgebiet des Solo Flusses auf Java. Das Quellenstudium umfasste zunächst die jeweiligen Projektberichte und -dokumentationen sowie inhaltlich erklärende oder ergänzende wissenschaftliche Veröffentlichungen; danach wurden die relevanten Rechtsgrundlagen und die dazu entwickelten Regelwerke (Ausführungsvorschriften, Richtlinien und Anweisungen) für die Umsetzung eines entsprechenden Managementansatzes entlang der Verwaltungshierarchie bzw. der räumlichen Zuständigkeiten erforscht und schließlich wurden die Beziehungen und Konsistenten zwischen diesen Rechtsgrundlagen und Instrumenten eruiert. Die Ergebnisse wurden involvierten Experten und Schlüsselpersonen vorgelegt, die mit Hilfe eines offenen, grob vorstrukturierten Gesprächleitfadens zu den Hintergründen, zum Projektverlauf und zu Projektergebnissen befragt wurden. Bedingt durch diese Rekonstruktion des Projektverlaufes wurde jedes Projektgebiet mehrfach besucht, und der Besuch dazu genutzt, sich ein eigenes Bild von der jeweiligen Lage zu verschaffen und gegebenenfalls nach weiteren Informationen zu suchen.

Die Analyse betrachtet den Umgang mit den Prinzipien des ökosystemaren Ansatzes, gegliedert nach drei wichtigen Themenbereichen, nämlich: 1) den Einsatz eines adaptiven Managements, 2) die Berücksichtigung der gebietsspezifischen Verhältnisse und des Zustandes der jeweiligen Ökosysteme im Hinblick auf deren Aufbau, Funktionen und Integrität, und 3) die Einbeziehung von Stakeholdern und Wirtschaftsaspekten.

Der erste Teil konzentriert sich auf das adaptive Management, besonders im Zusammenhang mit Organisations- und Verwaltungsaspekten. Die Ergebnisse der Studie zeigen, dass der Forstwirtschaftssektor in Indonesien strukturell seine Repräsentanz bis auf die lokale Ebene ausgeweitet hat. Allerdings mangelt es immer noch an angemessenen und zielführenden Verwaltungsrichtlinien zur Sicherung und Stärkung der biologischen Vielfalt und zum Schutz der Umwelt. Die derzeitigen Bestimmungen in der Forstwirtschaft sind ungeeignet, um mit den rapiden Entwaldungs- und Urbanisierungsprozessen im

Untersuchungsraum umzugehen, denn sie sind ausschließlich auf die noch bestehenden Restwaldflächen ausgerichtet.

Der zweite Teil befasst sich mit raumbezogenen Fragen zu Strukturen, Funktionen und Integrität der Waldökosysteme. Alle untersuchten Fälle zeigen, dass essentielle Grundsätze für einen zeitgemäßen Naturschutz sowie die technische Unterstützung und Durchführung fehlen. Aspekte wie die ausreichende Größe von repräsentativen Gebieten, der räumlich-funktionale Verbund von Habitaten, der Uferschutz oder die Berücksichtigung von Gebieten ohne Schutzstatus in einem umfassenden Schutzkonzept für den landwirtschaftlichen und urbanen Bereich bisher auf keiner Ebene forstlicher Zuständigkeiten berücksichtigt oder gar unterstützt worden sind

Der dritte Teil der Analyse beschreibt die Berücksichtigung von Stakeholdern und Wirtschaftsaspekten. Die Ergebnisse machen deutlich, dass: 1) sich die Teilnahme und Berücksichtigung von Stakeholdern auf die Forstwirtschaftprogramme *'social forestry'* und *'community forestry'* und dabei auf die Funktionen der Güterproduktion und einzelne Fragen des Waldschutzes beschränkt. Allerdings umfasst sie auch die Zusammenarbeit zwischen Regierungsorganen, Geschäftssektoren und den Bauern 2) sich die ökonomischen Steuerungsmechanismen seitens der indonesischen Forstwirtschaft auf Anreizmechanismen beschränken, nicht jedoch Umweltkosten und Nutzen internalisiert werden oder gar finanzielle Abschreckungsmechanismen entwickelt worden sind, obwohl diese als Bestandteile des Umweltschutz- und Wirtschaftsrechtsgesetzgebung vorgesehen sind.

Damit lässt das Forstmanagement in Indonesien noch immer entscheidende Lücken in der Umsetzung der EsA Managementprinzipien erkennen, wenngleich es v.a. wesentliche regulative und strukturelle Verbesserungen als Voraussetzung für die Umsetzung des ökosystemaren Ansatzes erfahren hat.

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Glossary

basin	The area of land that drains to a given water body, such as a lake or stream.
biodiversity	The entire diversity of life, usually defined to include all of the species, genes, and ecosystems on earth or within a given area.
biological disturbance	A discrete or ongoing event in which the proliferation of a plant, animal, or disease organism profoundly alters the functioning of a natural community.
biotic	Pertaining to living organisms.
community	All of the organisms living and interacting within an area; in other words, the living components of an ecosystem.
conservation objectives	A series of measures required to maintain or restore the natural habitats and the populations of species of wild fauna and flora at a favourable status at any levels (at local, regional, national).
core habitat	The areas on the landscape conservation and development plan designed for nature reserves.
corridor	A landscape feature that is long and relatively narrow that either connects two or more patches or interrupts or dissects the matrix. Roads, streambanks, hedgegrows, and ribbons of natural habitat are all examples of corridors.
designated function	Function or purpose assigned to a piece of land either by legal prescription or by decision of landowner/manager.
disturbance	Any event is all significantly changes the environmental conditions or resources available to the biota. Disturbances can be natural physical events, such as volcano eruptions, hurricanes, landslides, and fires; natural biological events, such as pests or disease outbreaks; or human-induced events, such as ploughing, logging, and mining. Disturbances can occur at any scale.
ecological function	Functions related to protection and environmental conservation.
ecological integrity	The condition in which ecosystems retain their natural structure and function and able to sustain themselves indefinitely with minimal human intervention. An ecosystem's integrity is based on such factors as its biota (genes, species, and communities), physical environment (soil and water), and ecosystem processes (biotic interactions, nutrient flows, energy dynamics).
ecology	A wide-ranging scientific discipline that seeks to examine, explain, and predict how species interact with one another and with the nonliving world.
ecoregion	An area of land – typically on the order of hundreds of miles or kilometres across- consisting of several different landscapes but united by common environmental conditions, species, and disturbance processes.
ecosystem	A group of living organisms plus their nonliving environment, including soil, water, nutrients, and climate. Forests, grasslands, deserts, and lakes are all examples of ecosystems.

ecosystem functioning	A dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit. Ecosystems are not only important in terms of the species they contain, but also in terms of the functions they carry out.
ecosystem structure	All the living and nonliving physical components that make up that ecosystem. The more components that make up an ecosystem, the more complex its structure becomes.
ecosystem approach	A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an adequate way.
ecosystem function	All of the natural ecological processes that occur within an ecosystem.
ecosystem services	Ecosystem functions that provide economic utility to humans, such as flood control, water purification, and nutrient cycling.
endemic species	Species that are found only in a restricted geographic area. A species (or genus or family) may be endemic to a very small region, such as an island, or to entire continent or hemisphere.
fragmentation	The process that occurs when human land uses such as agriculture and urban areas divide native habitats into discontinuous patches.
landscape	An area of land-usually tens of miles or kilometres across –in which a given combination of local ecosystems or land use is repeated in similar form. This is roughly the area of land that one can see from a mountaintop or an airplane.
landscape ecology	The branch of ecology that studies the form and function of features on the landscape.
meta population	A group of linked populations living in distinct habitat patches. Although population is at risk of dying out, the meta population as a whole may survive as individuals recolonize the habitat patches from other populations.
migration	Seasonal movement from one habitat to another, usually along latitudinal or altitudinal gradient.
native biodiversity	Individuals, populations, species, and ecosystem that are indigenous to a given area (i.e., that were not transported there by humans).
patch	Discrete land use, vegetation type, or other landscape element that is distinct from the surrounding matrix.
population	A group of individual of single species that all live in the same place and that are somewhat isolated or distinct from other population. Members of a population interact with another much more than they do with members of other populations.
primary production	The process of plants converting sunlight to stored chemical energy in plant tissue. Also, a total amount of plant growth (or energy captured) in a given organism, community, or ecosystem.
restoration	The process of returning an ecosystem to its original condition or state.
species richness	A simple measure of biodiversity; the count of the number of species found in an area.

stepping stone A disconnected patch or island of suitable habitat in a matrix of less suitable habitat. Stepping stones can aid in the migration and dispersal of many birds, insects, and other species.

sustainability The combination of ecological integrity with the human objectives of long-term economic prosperity and social equality.

urban areas The areas on the landscape conservation and development plan designated for residential, commercial, and industrial development at urban or suburban densities.

watershed *see basin*.

List of Abbreviations and Acronyms

BKSDA	*Balai Konservasi Sumber Daya Alam* (Nature Conservation Agency)
BPKH	*Balai Pemantapan Kawasan Hutan* (Regional Office for Forest Planning).
BPS	*Badan Pusat Statistik* (Statistics Indonesia)
BRLKT	*Balai Rehabilitasi dan Konservasi Tanah* (Land Rehabilitation and Soil Conservation Institute)
BS	Bengawan Solo
CBD	Convention on Biological Diversity
COP	Conference of the Parties
DepKimpraswil	*Departement Pemukiman dan Prasarana Wilayah* (Ministry of Settlements and Regional Infrastructure)
DG	Directorate General
EIA	Environmental Impacts Assessment
EIS	Environmental Impact Statement
EsA	Ecosystem Approach
ESCAP	Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organization
FLR	Forest Land Rehabilitation
FMU	Forest Management Unit
GOI	Government of Indonesia
GR	Government Regulation
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
MEA	Millennium Ecosystem Assessment
MoE	Ministry of Environment
MoF	Ministry of Forestry
PHPA	*Perlindungan Hutan dan Konservasi Alam* (Forest Protection and Nature Conservation).
SFM	Sustainable Forest Management
SWOT	Strengths, Weaknesses, Opportunities and Threats
UNEP	United Nations Environment Programme
WCMC	World Conservation Monitoring Centre
WRI	World Resources Institute

APPENDICES

Appendix 1. Assessment Table

Issue	Dimension	Description	It will be verified
Adaptive Management	Planning	1. Management system in place 2. Commitment/goal of organization e.g. long term goal. 3. Resources 4. Local variations.	• Management system: Procedures/ standards, norms and records. • Long run goal for forest ecosystems. • Internal communication and inter-sectoral (local governments, environment agencies, other development sectors). • Program's connection (vertical and horizontal). • Mechanisms (spell-out in regulations) to accommodate community's initiative e.g. on rehabilitation and other environmental programs.
	Management	1. Forest as a continuum and managed by the appropriate management levels. 2. Forestry department, regencies and community take initiatives on forest development. Coordination is taken by forestry department at appropriate level.	• Forestry commitment to ecosystem approach. • Appropriate a set of regulation • Up-dated management system regarding forest management and their conditions to the lowest necessary level. • Guidelines for other development sectors and the relation to forestry e.g. agreements / mechanisms for intersectoral communication and collaboration
	Implementation	1. Role of foresters. 2. Role of stakeholders 3. Communication and collaboration mechanisms with forestry sector for any type of land uses.	• Commitment is understood and implemented at all levels and possible stakeholders. • Clear operational tasks. • Perform diverse forest functions concerning ecological functions of forests at all type of ecosystems, e.g. EIA projects reports, impacts measurement including after projects relating to forests functions i.e. to reduce pollutions.
	Control / Monitoring	1. Management's feedbacks of the implementation of the adopted system in place, based on - Records - Conflicts	• Adequate guidelines and their availability. • Trend of implementation of forest development as well as their information quality (spatially and in time series). • Feedbacks i.e. commands and/or suggestions. • Identify the needs of improvement.
Area and Ecosystem Structure, Functions and Integrity	Planning	1. Forest Planning based on functions. 2. spatial scale 3. connectivity 4. local conditions/ characteristics incl. recognize the sequence of nature change temporal scale; cultural background. 5. consider interactions between forest ecosystems, watershed and landscape level incl. impacts to the adjacent area. 6. Involving scientific achievements.	• Overlay functions based on i.e. ecoregion, nature characteristics, nature given, current land uses and coverage. • Forest in continuum. • Consider biological diversity, threathened species, and unknown species. • Promote complexity, diversity and local variability. • Defining the main functions of areas and their sub-functions. • Management to up-date information regarding to forest structure, function and integrity. • Ecological impacts from forest designation. • Environmental plans for function's recovery on regarding area.
	Management	A clear of areas designation and delineation (and accepted by community)	• Adequate guidelines cover all ecosystems type. • Strategies/mechanisms to preserve and possibility to extend / improve forests to aim conservation objectives and better environmental condition. • Mechanisms to manage 'conflict' between functions e.g. re-designation, revision etc.

Issue	Dimension	Description	It will be verified
Area and Ecosystem Structure, Functions and Integrity	Implementation	1. Techniques and methods i.e. silviculture, protection, zonation etc. that adequate with the designed function. 2. Local practices	• Identification of all potential area to aim conservation objectives. • Formulation of silviculture techniques to supports forest functionings. • Consider local practices and experiences.
	Control/ Monitoring	Monitoring forest/land functions based their performance: 1. Areas designation 2. Species richness/extinction, population number, size of area, environmental conditions etc. 3. Connectivity, forms, types and level of pollution relating to ecological impacts.	• Trends of Species number, numbers of population and their habitat condition, size of area as well as their connectivity • Trends of level and types of pollutions particularly in urban areas. • Multifunctionality of forests, particularly to aim conservation objectives.
Stakeholders and Economic	Planning	1. Societal choice 2. Relevant information and capacity building 3. Land ownership types and their obligations to the environment 4. Economic instruments /mechanisms	• Biodiversity strategies and action plan apply at local level and as a societal choice. • Relevant information to stakeholders e.g. scientific achievement, local knowledge and practices, experiences, innovations and practices. • Economic mechanisms against alternate land uses. • Mechanisms for communication and participation.
	Management	1. Identification of stakeholders 2. Mechanism of participation 3. Conflict management 4. Application of economic instruments	• Identification of local values on forests particularly on ecological aspects. • Identification of stakeholders. • Guidelines regarding economic instrument mechanisms to preserve the biodiversity and the environment. • Schemes for capacity building on managing biodiversity (at communal level) • Develop a better approach of participation • System to economic mechanisms.
	Implementation	1. Explicit participation by stakeholders i.e. consultation in EIA process. 2. Formulation from all parties 3. Environmental impacts of development/designation, cost and benefits for local community.	• Explicit participation by stakeholders on nature protection (respecting to the designed functions of area) in public lands or privately owned lands. • Public hearing and communication process. • Application of economic mechanisms. • Application of incentive, disincentive and economic valuation.
	Control / Monitoring	1. Rehabilitation success. 2. Economic valuation. 3. Biological diversity used 4. Measurement of environmental conditions.	• Size of rehabilitated areas. • Trends of unproductive lands. • Rewards (e.g. compensation), punishment for ecological reasons. • Environmental (benefit) performance e.g. biological diversity used, number / level of accidents e.g. flood, sedimentation.

Appendix 2. Forest Functions according to GR No.34/2002 on Forest Arrangement and Planning for Management and Utilization in the Designated Forests (Forestry Sector).

No	Forest Sphere	Sub-sphere 1	Sub-sphere 2	Area's Criteria	Forest Arrangement	Forest Utilization
I	Conservation Forest	Nature Reserve Forest	Nature Reserve Forest	*-Criteria of this sub-sphere is not determined by the GR No.34/2002-.*	Determine the area boundaries; inventarization and identification of the potential values and condition including constrains; forest description; measurement and mapping.	Forbidden
			Game Reserve Forest	A habitat for (an) intended species contains diversity and high population of fauna; a habitat of endangered/ almost extinct species; a habitat for a certain migrating species; and/ or an area has an adequate size for (an) intended species.	Equal with above arrangement, but this arrangement is in blocks including marking.	Follows GR No. 68/1998
		Nature preservation forest	National Park	*-Criteria of this sub- sphere is not determined by the GR No. 34/2002-*	Determine the boundaries of area; inventarization, identification, and description condition of the determined area, including data of the surrounding area (social, economic and culture); Zonation arrangement: core, utility and others, including marking; measurements and mapping.	Forbidden in core-zone and natural forest-zone; others. Follows GR No. 68/1998
			Grand Forest Park	*-Criteria of this sub-sphere is not determined by the GR No. 34/2002-*	Equal with above arrangement but in blocks: utility, flora collection, protection and other, including their marking.	Follows GR No. 68/1998
			Nature Recreation Park	*-Criteria of this sub-sphere is not determined by the GR No. 34/2002-*	Equal with above arrangement but in blocks: intensive utility, limited on utility and other, including marking.	Follows GR No. 68/1998

No	Forest Sphere	Sub-sphere 1	Sub-sphere 2	Area's Criteria	Forest Arrangement	Forest Utilization
II	Protective Forest	Hunting park	----	- An area has reasonable size for safety; and/or contains (cultivated) animals to be hunted, to maintain hunting activities regularly as for recreation, sport and fauna preservation. - State forest with score >175, or slope >40%, or at >2000 m a.s.l, or has soil that sensible from erosion with slope >15%, or as water retention area, or as coast protection area.	Equal with above arrangement but in blocks: hunting, utility, faunal breeding and other, including marking. Determine the area boundaries,; inventarization, identification, description of area condition, social, economy and culture data compilation in forest and the surround; arrangement in blocks: protection, utility and other; registration; measurement and mapping.	Follows GR No. 13/1994. Only applied in 'block utility' (to BUMN /BUMD/BUMS through licence/permit system)
III	Production Forest	Limited Production Forest	----	Score 125 – 174, outside protective forest, conservation forest, preservation forest and hunting park.	Determine the area boundaries; inventarization of forest conditions: flora-fauna species and their distribution, project plan (size, boundaries and enclave plan), social, economy and culture data, status, function and land cover, soil type, slope, climate, human resources (demography), hydrology condition, landscape and natural conditions; arrange in blocks and plots including marking; registration; measurement and mapping.	Utilization can be applied (to BUMN/BUMD/BUMS through licence / permit system) such as on area, environmental services, wood, non-wood extraction either from natural or plantation forest.
		Permanent Production Forest	----	Score < 125 and, outside protective forest, conservation forest, preservation forest and hunting park.		
		Convertible Production Forest	----	Score < 124, and outside protective forest, conservation forest, preservation forest and hunting park. Reserving for transmigration, settlement, agriculture and estate crop.		

Urban Forest according to GR No. 63/2002 on Urban Forest				
Urban Forest	Settlement	*-Criteria of this spheres is not determined by the GR No. 63/2002-*	Determination of urban forest's forms (line / rug / disperse) depend on the landscape characteristics.	*-Allowing utilizations in urban forests are not determined by the respective GR*
	Industrial			
	Recreation			
	Genetic preservation			
	Protection			
	Security			

Appendix 3. Functions Classification according to GR No. 26/2008 on National Spatial Planning.

Sphere function	Sub-function 1	Sub-function 2	Criterion
Protective Sphere	Protection for the lower areas	Protective Forest	Score >= 175; Slope > 40%; Altitude >= 2000 meter a.s.l
		Peat-most	Peat-most with >=3 m. thick a located at upper river/swamp.
		Water Retention	high precipitation; has soil structure and geomorphology that can retain high capacity of rain water
	Local protection	coast buffer area	100 m from the highest tide-line along coastline
		River Buffer- zone	With embankment: 5 m outside embankment-foot; Main river, without embankment outside settlement area 100 m to land from the river line; River branches, without embankment, outside settlement, area 50 m from river line.
		Reservoir / Lake buffer	50 -100 m from the highest tide-line; or proportionally with form and physical condition of the reservoir
		Green Space Urban Area	2500 m2 area in block, lines or their combination and dominated with woody plants community
	Nature Conservation , Nature Preservation and Cultural Reserve *(Kawasan Suaka Alam, Pelestarian Alam dan Cagar Budaya)*	Nature Reserve *(Suaka Alam)*	Ecosystem and unique biological diversity; Main function as biological diversity, ecosystem, and it unique characteristic preservation.
		Game Reserve *(Suaka Margasatwa)*	as a habitat for certain faunal breeding that require conservation; and or contains high fauna diversity; and or as a or living place for certain faunal migration species; and or place considerably in size as habitat for the respective species.
		Nature Reserve *(Cagar Alam)*	Diversity on flora, fauna and ecosystem, and or represent certain biotic formation or its elements natural, good condition (biotic or physically), undisturbed by human, and or represent on size and form, so that effective for management including for its buffer zone; unique, single example in the area where a conservation is needed.
		Mangrove Coastline	Corridor along the shoreline with minimally 130 times of the average annually highest tide-line-lowest tide-line is measured from the lowest tide-line to the land.
		National Park	Permanent forest with high biodiversity; considerably wide area (size) to secure natural ecological process; unique natural resource with flora, fauna and its ecosystem in natural condition; minimum contains 1 ecosystem where is materially and physically shall not be changed or exploited; natural condition for eco-tourism
		Grand Forest Park	Forested or covered with diversity of permanent vegetation; appreciable landscape architecture; has an access for tourism; natural- or man-made area in natural or 'changed' ecosystem; has natural beauty, accessible and close to settlement; reasonably size for collection of indigenous and or exotic flora and or fauna.
		Recreation Park	Naturally attractive: flora, fauna and their natural ecosystem, has an unique geological formation; reasonably size for preservation natural resource and their ecosystem for eco-tourism; the surround condition supporting the development of the eco-tourism purposes; accessible for visitors
		Science and Cultural Reserve	Contain a high value of culture that is useful for science.
	Natural disasters sphere	landslide	A slope area that potential affected to erosion.
		Tsunami	--
		Flood	Area that potential affected to flood.

Sphere function	Sub-function 1	Sub-function 2	Criterion
Protective Sphere	Geological protection-sphere	Nature Reserve for geological reasons	Unique stone and fossil, landscape and geological processes.
		Geological nature disaster	Volcano, earthquake, tsunami, abrasion, toxic gases.
		Ground-water protection	Groundwater source and reservoir (200 m to land).
Protective Sphere	Others	Biosphere Reserve	Representing natural-, degraded-, modified- and or restored ecosystem; unique, rare, aesthetical of natural community and harmony with human activities, and or a wide landscape that reflecting a harmony interaction between natural community and human activities, and or a place for monitoring an ecological changing through research and education activities.
		Ramsar	A unique natural or near-natural wetlands; Support fragile species, endangered and near-endangered, or community ecology; support floral and faunal biodiversity; evacuation place for flora and fauna in critical conditions.
		Hunting Park	Representative size and not dangerous for hunting activity; cultivated fauna for regular hunting, as recreational, sport and preservation purposes
		Genetic Resource	Contains a certain genetic resource that could not find in anywhere else in the defined conservation area; reasonably in size to preserve naturally.
		Fauna Evacuation	Origin area of the current endemic fauna, and or new place for the evacuated fauna; reasonable on size to preserve their natural process and breeding.
Cultivation Sphere	Production Forest	Limited Production	Score (based on criteria: slope, soils type and precipitation intensity): 125 – 174.
		Permanent Production	Score < 124,
		Convertible Production	Score < 124; and or an area if being converted can still support the environment.
	Tree Garden (*Hutan Rakyat*)		Area that can be managed as forest by private land holder.
	Agriculture		Appropriate as agricultural land; sustainable land for agriculture support national food security; and/or can be extended along with water availability.
	Fisheries		Catching, culturing, and fisheries end product industry area; and/or other consideration under the respective ministry.
	Mining		Categories as national strategy, i.e. mineral, coal, oil and gas, earth thermal and fresh water; area that can be used for mining to real economy.
	Industrial Estate		Area for industrial estate: shall not disturb the environment; shall not change productive lands.
	Recreation		Contains tourist attraction, and or support culture, scenic beauty and environmental efforts.
	Settlement		Outside natural disaster area; have accesses to community centre of activity; and/or has an infrastructure, services and support system.
	Others		

Appendix 4. Designated Conservation Areas in the Bengawan Solo River Basin

No.	Designated Conservation Area	Category	Decree	Location	Size (ha)	Forest Ecosystem Type	The Biological Diversity Potential of the Area
1	Bekutuk	Nature Reserve	No. 596 /1979	Blora (Central Java)	25,4	Lowland dry-forest	**Flora:** *Tectona grandis;* **Fauna:** Kangkareng (*Anthracoceros sp*), Alap-alap (Accipitridae), Raja Udang (*Alcedo sp*), Burung Madu (*Lichmera flavicans*), Kutilang (*Pycnonotus aurigaster*).
2	Mt. Merapi	National Park	No. 134 of 2004	Sleman, Magelang, Klaten, Boyolali (DIY and Central Java)	6410	Tropical forest Vulcan: - Upper zone (xyrocere process= a primary succession on the dry-stone forest): dominated by moose, grass, herbal and shrub; -Middle-zone: tropical mountain forest; -Lower-zone: agroforestry (grass-comercial comodities-holticulture-food-wood).	**Flora:** 72 flora species. Primary forest: dominated by species Serangan (*Castanopsis argentia*); secondary forest is dominated by species puspa (*Schima walicii*) and pinus (*Pinus merkusii*). Others: *Acacia decurens, Bambusa spp, Albizia spp, Euphatorium inufolium, Lithocarpus elegans, Leucena galuca, L.leucoocephla, Hibiscus tiliaceus, Arthocarpus integra, Casuarina sp, Syzygium aromaticum, Melia azadirachta, Erytrina variegata*,and *Ficus alba*. Orchides>47 species, incl. endemic and rare orchids e.g. *Vanda tricolor*. Most used by people: grass *(Imperata cylindrical), Panicum reptans, Antraxon typicus* and *Pogonatherum paniceum.* **Fauna**:Mamalia: macan tutul (*Panthera pardus*), kucing besar (*Felis sp*), musang (*Paradoxurus hermaprodus*), bajing (*Laricus insignis*), bajing kelapa (*Colosciurus notatusi*), kera ekor panjang (*Macaca fascilcularis*), lutung kelabu (*Presbytis fredericae*), babi hutan (*Sus scrofa /vittatus*), kijang (*Muntiacus muntjak*), and rusa (*Cervus timorensis*); Birds >99 sprcies, endemic: elang jawa (*Spizaetus bartelsi*), bondol jawa (*Lonchura leucogastroides*), burung madu jawa (*Aethopyga mystacalis*), burung madu gunung (*A. eximia*), cabai gunung (*Dicaeum sanguinolenium*), cekakak jawa (*Halcyon cyanoventris*), Gemak (*Turnix silvatica*) and serindit jawa (*Loriculus pusilus*). Others: elang hitam (*Ictinaetus malayensis*), jalak suren (*Strurnus contra*), betet (*Psittacula alexandri*), alap-alap macan (*Falco severus*), elang bido (*Spilornis cheela*), and walet gunung (*Collocalia volcanorum*). Reptiles: ular sowo (*Dytas coros*), ular gadung (*Trimeresurus albobabris*) and bunglon (*Goneocephalus sp*).

No.	Designated Conservation Area	Category	Decree	Location	Size (ha)	Forest Ecosystem Type	The Biological Diversity Potential of the Area
3	Mt. Merbabu	National Park	No. 135 of 2004	Magelang, Semarang, Boyolali (Central Java)	5725	Mountaneous tropical forest: -Lower montane forest: 1000-1500 m asl; -Upper montane forest: 1500 - 2.400 m asl; -Sub-alpine forest: 2400 - 3142 m asl.	Clean water resources. **Flora**: pinus (*Pinus merkusii*), akasia (*Acacia decuren*), bintami (*Cupressus sp*), suren (*Toona sureni*), nangka (*Artocarpus integra*), waru (*Hibiscus sp*), kayu manis (*Cynamomum burmanii*), cengkeh (*Syzigium aromaticum*), alpokat (*Persea americanai*), sengon (*Albizia falcataria*), cemara gunung (*Casuarina montana*), puspa (*Schima wallichi*), and bambu apus (*Gigantochloa apus*); **Fauna:** Mamalia: kera ekor panjang (*Macaca fascicularis*), lutung hitam (*Tracypithecus auratus*), lutung kelabu (*Presbytis fredericae*), kijang (*Muntiacus muntjak*), musang (*Herpates javanica*), landak (*Histrix sp*), luwak (*Paradoxurus hermaproditus*), and macan tutul (*Panthera pardus*).; Aves: Elang hitam (*Ichtinaetus malayensis*), alap-alap sawah (*Falco peregrinus*), kutilang (*Pynnonotus aurigaster*), bentet (*Lanius schach*), caladi/pelatuk ulam (*Picoides macei*), sepah gunung (*Pericrocotus miniatus*), rajaudang biru/tetengkek (*Halcyon chloris*), srigunting kelabu (*Dicrurus leucophaeus*), sepah hutan (*Pericrocotus flammeus*), ayam hutan (*Gallus varius*), kipasan gunung (*Rhipidura perlata*), cinenen kelabu (*Orthotomus sepium*), tekukur (*Streptopelia chinensis*), punglor/br.kacamata gunung (*Zosterops montanus*).
4	Ngargoyoso	Grand Forest Park	No. 849/1999	Karanganyar (Central Java)	231,3	n.i	**Flora:** Pinus (Pinus sp), Puspa (Schima sp), Akasia (Accacia ducuren), Pampung (Unanthe javanica), Kina (Chinehna sp), Pasang (Quercus spp), Kayu Uni, Palem (Palmae sp), Kopi Hutan (Coffea sp), and Kaliandra (Calliandra sp) **Fauna:** Elang Ular Bido (*Spilornis cheela*), Elang Jambul Hitam (*Ictinaetus malayensis*), Elang Belalang (*Microhierax fringgilarius*), Cengekan, Ayam Hutan Hijau (*Gallus varius*), Punai Manten (*Treron griseicauda*), Tekukur (*Streptopilia chinensis*), Wiwik Lurik (*Cacamantis sonneratii*), Walet Sapi (*Collacalia escrienta*), Kapinis Jarum Kecil (*Rhaphidura leucopygialis*), tepekong Jambul (*Hemiprocae longipennis*), etc.
5	Mt. Picis	Nature Reserve	GB No.36 Stbl No. 43/1924	Ponorogo, (East Java)	27,9	Mountaineous Rain-forest	**Flora**: Rasamala (*Altingia exelsa*), Puspa (*Schima wallichii*), Pasang (*Quercus sp*), Beringin (*Ficus sp*). **Fauna**: Merak (*Pavo muticus*).
6	Mt. Sigogor	Nature Reserve	GB No.23 Stbl. No.471/1936	Ponorogo (East Java)	190,5	Mountaineous Rain-forest	**Flora**: Rasamala (*Altingia exelsa*), Puspa (*Schima wallchii*), Pasang (*Quercus sp*), Cemara Gondok, Beringin dan Jaban; **Fauna**: Macan tutul (*Panthera pardus*) and Merak (*Pavo muticus*), Babi hutan (*Sus sp*), Kera abu-abu (*Macaca fascicularis*), Kera hitam (*Presbytis cristatus*), Kijang (*Muntiacus muntjak*), Bido (*Spilornis cheelabido*).

Appendix 5. Ecoregions in the Bengawan Solo River Basin

No	Ecoregion	Natural Characteristics				Current Status	
		Zone	Forest Type	Distinctive Species or Family (indicator)	Biodiversity Feature	Types and Severity of Threats	Overlapping Basin & Conservation Area*
1	Western Java Montane Rain Forest (represents the montane forests of west Java; Köppen climate zone: tropical wet climate zone)	2-3 dry months	Evergreen Rain Forest	*Artocarpus elasticus* (Moraceae), *Dysoxylum caulostachyum* (Meliaceae), langsat (*Lansium domesticum*) (Meliaceae), and *Planchonia valida* (Lecythidaceae).	**Richness & Endemism:** moderate; **Species Extinct:** Javan tiger (*Panthera tigris sundaicus*); **Endangered species:** Mammal: 64 sp.,14 Endemics/near endemics: Javan/Surili leaf monkey (*Presbitys comata*), Java gibbon (*Hylobates moloch*), yellow-throated marten (*Martes flavigula robinsoni*) and leopard on Java (*Pantera pardus melas*).; Birds: >230:30 endemics/near endemics; the endangered Javan hawk-eagle (*Spizaetus bartelsi*) and the vulnerable volcano swiftlet (*Collocalia [Aerodramus] vulcanorum*), Javan cochoa (*Cochoa azurea*), and Javan scops-owl (*Otus angelinae*). **Unique species:** Mammal i.e. *Crocidura orientalis, Glischropus javanus, Hylopetes bartelsi, Mus vulcani, Maxomys bartelsii, Pithecheir melanurus, Kadarsanomys sodyi.* Birds: *Arborophila javanica, Otus angelinae, Aerodramus vulcanorum, Megalaima corvina, Cochoa azurea, Psaltria exilis, Tesia superciliaris, Alcippe pyrrhoptera, Crocias albonotatus*.	20 protected areas, total coverage 3.410 km2 (13%) of the ecoregion; several have size > 100 km2 but none exceed >500km2; protected habitats represent isolated mountains (usually volcanic peaks) that are scaterred throughout the mountains chain.	Proposed Protected Areas by WCMC (*) [Area; IUCN Category] = 0; Designated by GOI [Area] = National Park (TN) Mt. Merbabu [6410 ha] and National Park (TN) Mt. Merapi [5725 ha].
			Semi-evergreen Rain Forest				
		lower montane	Aseasonal- montane Forest	Lithocarpus, Quercus, Castanopsis, and Laurels (Fagaceae and Lauraceae), Magnoliaceae, Hamamelidaceae, and Pococarpaceae, *Atingia excelsa, Podocarpus spp*, tree ferns.			
	Transition lowland-montane	>1.000 m a.s.l.		Anemone, Aster, Berberis, Galium, Gaultheria, Lonicera, Primula, Ranunculus, Rhododendron, Veronica, and Viola.			
		>1.200 m a.s.l.		lowland tree species is out			
	Transition lowland to upper montane	>1.800 m a.s.l.		Aerobryum moss, Dacrycarpus (Podocarpus), Ericaceae shrubs, Rhododendron, Vaccinium, and Gaultheria.			
		> 3.000 m a.s.l.	Sub-alphine Forest	Edelweiss (*Anaphais javanica*)			

No	Ecoregion	Natural Characteristics				Current Status	
		Zone	Forest Type	Distinctive Species or Family (indicator)	Biodiversity Feature	Types and Severity of Threats	Overlapping Basin & Conservation Area*
2	Western Java Rain Forest (represents the lowland moist forests of western Java (<1,000 m), Köppen climate zone: tropical wet climate zone to seasonal).		Evergreen Rain Forest	No single tree family is dominated; *Artocarpus elasticus* (Moraceae), *Dysoxylum caulostachyum* (Meliaceae), langsat (*Lansium domesticum,* Meliaceae), and *Planchonia valida* (Lecythidaceae).	**Richness & Endemism:** moderate; **Species Extinct:** Javan tiger (*Panthera tigris sundaicus*); Javanese (bird) lapwing (*Vanellus macropterus).* **Endangered species:** Mammal:101 species, 5 endemics and near endemics, the critically endangered Javan rhinoceros (*Rhinoceros sondaicus*) and Javan gibbon (*Hylobates moloch*), the globally threatened surili (or Java) leaf monkey (*Presbytis comata*), fishing cat (*Felis viverrina*), wild dog (*Cuon alpinus*), Javan warty pig (*Sus verrucosus*), banteng (*Bos javanicus*), and slow loris (*Nycticebus coucang*), the endangered Javan sub-species of the yellow-throated marten (*Martes flavigula robinsoni*) and leopard on Java (*Pantera pardus melas*). Birds: >350 species; 9 endemics and near endemics. **Flora:**> 3,800 species, 2 endemic genera, these forests harbor 2 species of the giant insectivorous Rafflesia (*R. rochussenii* and *R. patma*)	Java is one of the most densely populated islands in the world, very little natural habitat remains. Anthropogenic fires are common and over centuries burning has resulted in monospecific stands of fire resistant species, usually *Tectona grandis* (FAO 1981). Most annual cropping systems, soils are left exposed during critical periods, resulting in extensive erosion (IUCN 1991). Illegal farming and felling are widespread, and an important timber tree *Altingia excelsa* has been nearly eliminated from the lowland forests (Whitten et.al 1996). Only about 5% original habitats of this ecoregion remain. There are 33 protected areas that totally cover 3,045 km^2 (7%), but most (28 protected areas) are small (<100 km^2).	Proposed Protected Areas by WCMC (*) [Area; IUCN Category] = 0; Designated by GOI [Area] = 0
		2-3 dry –months	Semi-evergreen Rain Forest (evergreen to seasonal)				
		Along northern coast; Precipitation 1,500 to 4,000 mm/yr ; 4-6 dry-months	Moist- deciduous Forest	Borassus and Corypha palms are good indicators of the seasonal climates that generate deciduous forest in the region.			
		Along northern coast; Precipitation <1,500 mm/yr with> 6 dry- months	Dry-deciduous Forest	*Homalium tomentosum, Albizia lebbekoides, Acacia leucophloea, A. tomentosa, Bauhinia malabarica, Cassia fistula, Dillenia pentagyna, Tetrameles nudiflora, Ailanthus integrifolia,* and *Phyllanthus emblica*. Many herbaceous plants			
			Azonal Limestone	no plant endemics			

No	Ecoregion	Natural Characteristics				Current Status	
		Zone	Forest Type	Distinctive Species or Family (indicator)	Biodiversity Feature	Types and Severity of Threats	Overlapping Basin & Conservation Area*
			Freshwater- swamp Forest	*Laeocarpus macrocerus, Alstonia spathulata,* wild mango (*Mangifera gedebe*), and *Stemonurus secundiflora*. Other rare plants include the sedge *Machaerina rubiginosa*, the aroid *Cyrtosperma merkusii*, and floating water plants such as *Hydrocharis dubia* and water chestnut (*Trapa maximoviscii*)			
3	Eastern Java-Bali Rain Forest (represents the lowland moist forests of eastern Java and Bali; Köppen climate zone: tropical wet and dry climate zones and seasonal).	Precipitation 1.500-4.000 mm/yr; 4-6 dry-months	Moist- deciduous Forests (with Semi-evergreen Rain Forest along the south coast)	Borassus and Corypha palms are good indicators of the seasonal climates that generate deciduous forests in the region; *Homalium tomentosum, Albizia lebbekoides, Acacia leucophloea, A. tomentosa, Bauhinia malabarica, Cassia fistula, Dillenia pentagyna, Tetrameles nudiflora, Ailanthus integrifolia*, and *Phyllanthus emblica*. Many herbaceous plants	**Richness and Endemism:** low to moderate. **Species Extinct:** Javan and Balinese tigers (*Panthera tigris sundaica* and *Panthera tigris*). **Endangered species:** Mammal (103 species): the endangered Bawean (or Kuhl's) deer (*Axis kuhlii*), the vulnerable Javan warty pig (*Sus verrucosus*), the endangered Javan yellow-throated marten (*Martes flavigula robinsoni*) and banteng (*Bos javanicus*), the endangered Javan subspecies of leopard on Java (*Pantera pardus melas*) (IUCN 2000). Birds (310 species):10 endangered and near endangered; critically endangered Bali starling (*Leucopsar rothschildi*) and the endangered Javan hawk eagle (*Spizaetus bartelsi*) (Stattersfield *et al.* 1998). **Unique species:** The endangered Bawean (or Kuhl's) deer (*Axis kuhlii*), *Leucopsar rothschildi* (bird)	Almost all natural habitats were cleared by logging interests and for agriculture and settlements to provide for a rapidly expanding and dense human population. Only tiny fragments of natural forests remain, but they are also disturbed to some degree. The largest remaining blocks of forest in this ecoregion are found at Lebakharjo and Bantur, along the coast south of Malang (Whitten *et al.* 1996). There are 18 protected areas covering 2,330 km2 (4%), although the majority are small (<100 km2). Anthropogenic fires are common and for centuries of burning have resulted in monospecific stands of fire-resistant species, usually *Tectona grandis* (FAO 1981). Shifting cultivation by large and rapidly expanding populations has led to extensive erosion (IUCN 1991).	Proposed Protected Areas by WCMC(*) [Area; IUCN Category] = Bekutuk [20 km2; I]; = Designated by GOI as Nature Reserve (CA) Bekutuk [25,4 ha]
		Precipitation <1,500 mm/yr; >6 dry-months.	Dry-deciduous Forest (along the north coast).				
		Slightly seasonal than in western Java, with 2-4 dry- months	Semi-evergreen Rain Forest	*Artocarpus elasticus* (Moraceae), *Dysoxylum caulostachyum* (Meliaceae), langsat (*Lansium domesticum,* Meliaceae), and *Planchonia valida* (Lecythidaceae).			
			Limestone Forest	no plant endemics			

No	Ecoregion	Natural Characteristics				Current Status	
		Zone	Forest Type	Distinctive Species or Family (indicator)	Biodiversity Feature	Types and Severity of Threats	Overlapping Basin & Conservation Area*
4	Eastern Java-Bali Montane Rain Forest (represents the montane forests of eastern Java and Bali; Köppen climate zone: tropical wet and dry climate zones).		Evergreen Rain Forest	*Artocarpus elasticus* (Moraceae), *Dysoxylum caulostachyum* (Meliaceae), langsat (*Lansium domesticum*, Meliaceae) and *Planchonia valida* (Lecythidaceae) (Whitten *et al.* 1996).	**Richness & Endemism:** low to moderate. **Species Extinct:** Javan and Balinese tigers (*Panthera tigris sundaica* and *Panthera tigris balica*); **Endangered species:** Mammal (100 species): *Megaerops kusnotoi*, wild dog (*Cuon alpinus*) and endangered Javan leopard (*Panthera pardus melas*) (Nowell and Jackson 1996; IUCN 2000). Bird (> 215 species):18 endemics and near endemics; the endangered Javan hawk-eagle (*Spizaetus bartelsi*) and the vulnareble Javan scops-owl (*Otus angelinae*) (Stattersfield *et al.* 1998).	Populations of Java are continually forced into steep, upper watersheds and more marginal environments, where they have had significant destructive effects on nutrient outflow, total water yield, peak storm flows, and stream sedimentation (IUCN 1991). Nearly 3/4 of the natural habitats of this ecoregion have been cleared by a rapidly expanding population. The remaining forest is scattered throughout the landscape as small patches, mainly limited to the steep slopes of the volcanoes. There are 12 protected areas covering 3,690 km2 (23%) of the ecoregion. The mountain range has more active volcanoes than anywhere else in the world. The vegetation of this ecoregion has been disturbed by repeated volcanic activity (MacKinnon and MacKinnon 1986). Fires are common, and *Casuarina junghuhniana*, a secondary forest species, occurs gregariously in burned areas (FAO 1981).	Proposed Protected Areas by WCMC(*) [Area; IUCN Category] = Mt. Picis [20 km2; I]Mt. Lawu [290 km2; ?] and Mt Liman Wilis [230 km2; ?] ; = Designated by GOI [Area] = Grand Forest Park (TAHURA) Ngargoyoso [231,3 ha], Nature Reserve (CA) Mt. Picis [27,9 ha], Nature Reserve (CA) Mt. Sigogor. [190,5 ha].
		Precipitation 1,500-4,000 mm/yr; with 4-6 dry-months	Moist- deciduous Forest	*Homalium tomentosum, Albizia lebbekoides, Acacia leucophloea, A. tomentosa, Bauhinia malabarica, Cassia fistula, Dillenia pentagyna, Tetrameles nudiflora, Ailanthus integrifolia, and Phyllanthus emblica.* Many herbaceous plants (Whitten *et al.* 1996).			
		Lower montane	Seasonal- and Aseasonal-montane Forests	Lithocarpus, Quercus, Castanopsis, Fagaceae, and laurels (Lauraceae). Magnoliaceae, Hammamelidaceae, and Podocarpaceae, *Atingia excelsa* and *Podocarpus spp.*, tree ferns.			
	Transition lowland-montane	>1.000 m a.s.l.		Anemone, Aster, Berberis, Galium, Gaultheria, Lonicera, Primula, Ranunculus, Rhododendron, Veronica, and Viola.			
		>1.200 m a.s.l.		lowland tree species out			
	Transition lower-upper montane	>1.800 m a.s.l.		Aerobryum moss, Dacrycarpus (Podocarpus), Ericaceae shrubs, Rhododendron, Vaccinium, and Gaultheria.			
		> 3.000 m a.s.l.	Sub-alphine Forest	Edelweiss (*Anaphais javanica*)			

Note: (*) Whitten *et al.* (1997)

Curriculum Vitae

AAN DYNA ANDRIANI SCHLIEP, born in Surakarta, Central Java - Indonesia on August 30, 1971. After finishing high school at *SMA Negeri 3* Surakarta (1989), she studied Forestry at the Department of Wood Product Technology, Gadjah Mada University (*UGM*), Yogyakarta, Indonesia. She attained her university degree (*Sarjana Kehutanan*) from *UGM* in 1994 as the best graduate.

After finishing her university degree, she worked in a group of a forest concession company in Jakarta and East Kalimantan (1994-1995). From 1995 to 1998 she was a consultant to serve client firms set up their management system accordance to ISO 9000. From 1999 – 2000 she continued her study in Master's applied science program of Environmental Management at the University of Western Sydney (*UWS*) Hawkesbury, Australia (awarded and funded by Australian Agency for International Development (AusAID)). From 2000 – 2001 she worked as a freelance consultant for a group of forest concession companies in Jakarta. She took part in various international training programs relating to forestry and environmental issues: on Forest Certification in Sweden and South Africa (awarded and funded by Swedish Development Cooperation Agency (SIDA)); and Local Environmental Management Course in Sweden and Indonesia (awarded and funded by SIDA). From 2002 – 2014 she was a PhD student at the Institute of Nature Conservation and Landscape Planning (previously: Institute of Forest Policy and Nature Conservation) Georg-August-Universität Göttingen in Germany (awarded and funded by *Deutscher Akademischer Austauschdienst e.V. (*DAAD).

She is married to Ingo Schliep. From 2007-2012 she took leave to take care of her two children: Leander Schliep, born in 2007 and Levana Schliep, born in 2009.