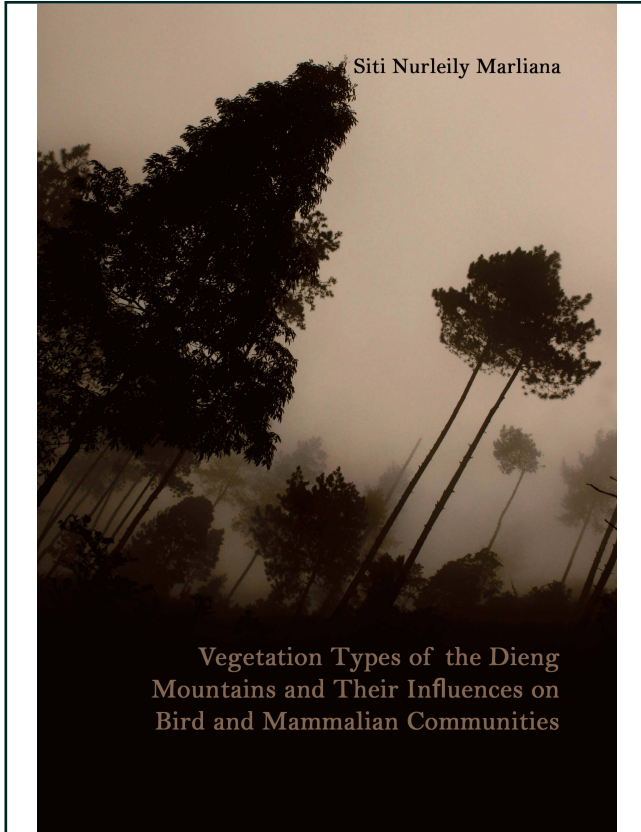Siti Nurleily Marliana (Autor)
Vegetation Types of the Dieng Mountains and Their Influences on Bird and Mammalian Communities

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1   GENERAL INTRODUCTION

1.1   Research Background

1.1.1   TREND OF DEFORESTATION IN INDONESIA

Changes in biodiversity at the global scale are driven by five major events: changes in land use, atmospheric CO_2 concentration, nitrogen deposition and acid rain, climate, and biotic exchanges (Sala et al. 2000). With regard to tropical forest biomes, Sala et al. (2000) also predicted that until the year 2100 habitat modification will continue to occur in tropical forests, with land use change as the major cause of biodiversity change. This phenomenon is typically prevalent in developing countries situated in tropical regions where people still rely heavily on natural resources for their livelihood, and where social and economic problems lead to conflicts over the use of natural resources.

     For Indonesia, a young nation that is still in its early phase of democratic development, such environmental problems are inevitable. As Indonesia ranks in the top five countries with the world's highest species diversity and has a high level of endemism, its change in land use and related problems may affect biodiversity on the global scale. In its 4th Report on the Convention on Biological Diversity, the Indonesian government indicates that some of the main threats to the long-term survival of Indonesian biodiversity are rapid population growth, deforestation, forest fires, habitat fragmentation, and overexploitation. The Indonesian Ministry of Forestry reported that in 2007 the deforestation rate in Indonesia was estimated to reach 1.6 million hectares per year (Indonesian Ministry of Environment 2009). Deforestation is claimed to be one of the main causes of biodiversity loss in Indonesia, along with the overexploitation of natural resources, rapid population growth, forest fires, habitat fragmentation, the introduction of alien species, pollution, and climate change. Following the economic crisis in 1997, the phenomenon of deforestation was at its peak, and its high rate was mostly due to illegal logging and timber looting. During the Reform period—that is, after the fall of the New Order regime in 1997—land encroachment for agricultural purposes was prevalent throughout the entire country. Additionally, widespread forest fires resulting from a strong El Niño in 1997 and 1998 aggravated the already severe forest degradation.

1.1.2   THE DECLINE OF JAVA'S FOREST COVER

Since the 1980s, montane forests in all the major Indonesian islands have been decreasing in size and deteriorating, including those on Java Island (Wikramanayake et al. 2002). In Java, which is inhabited by approximately 67 percent of Indonesia's population despite having only seven percent of the country's total area (Lavigne and Gunnell 2006), the pressure from population growth has resulted in severe deforestation and forest degradation, leaving only 8.2 percent of forest cover

remaining in 2006-2007, the lowest among Indonesia's major islands (Indonesian Ministry of Environment 2009). The poverty-induced social and economic problems in Java's uplands are characteristically accompanied by problems of physical and ecological degradation, and the growing awareness of the environmental crisis is not sufficient to ease the population pressure on the resources of the uplands (Palte 1984).

Java has a long history of forest exploitation, dating back even before the Dutch colonialism period around the 18th to 19th century, during which the Dutch government converted most of Java's forested areas into large scale timber and cash crop plantations. In addition, Junghuhn, cited by Smiet (1990), stated that the important causes of Java's deforestation between the late-18th and early-19th century were exploitation for fuelwood and land conversion into coffee plantations or settlement areas, and that around that time the forests on some mountains in Central Java had been cleared almost to the summit. Furthermore, in his description of the settlers' movement waves to Java's uplands, Smiet (1990) explained that during the second wave, which took place between 1860 and 1925, a series of land conversions set off by the colonial government policy of improving upland productivity replaced forests with agricultural land and cash crop (e.g. coffee, tea, and rubber) estates. Land scarcity caused by this policy forced farmers to intensify land use by abandoning the fallow period, and cultivating on steep slopes. The first half of the 20th century was marked by large-scale illegal cultivation, timber and fuelwood theft, grazing by domestic animals, and human-induced forest fires all over Java, which altogether led to severely degraded forest lands covered with grass or shrub. Reforestation efforts started in the 1920s, with mahogany *Swietenia macrophylla*, Sumatran pine *Pinus merkusii*, and dammar *Agathis dammara* as the most important species to be grown. The subsequent reforestation effort carried out during the independence era in 1976 aimed to reforest the upper slope areas and to introduce better cropping regimes. It failed because of over-centralization (Poel and Dijk 1987).

Population pressure continued the post-colonial deforestation and shrank Java's forest cover through land conversion into settlement areas and agricultural fields, leaving small, isolated forest patches situated on mountain tops. This alarming state of forest remnants had been predicted to jeopardize the long-term preservation of Java's natural ecosystem (Mackinnon et al. 1982). Even when the remaining natural forests can only be found on relatively remote mountains, they still suffer from exploitation by local people in search of firewood, timber, and fodder (Smiet 1990, 1992). Land and job scarcity pushes more people up towards the already functionally-impaired mountain areas as they look for a place on which to build their houses and farms. Degradation of montane forests accelerates through agricultural expansion combined with poor farming practices, which in turn brings about environmental catastrophes such as landslides, floods, and water shortage; all problems that are faced by the Dieng Mountains ecosystem, as will be further detailed in section 1.1.3. As stated in the Agenda 21, most mountain areas in the world are experiencing environmental degradation because of their susceptibility to ecological

changes. For this reason, chapter 13 of the Agenda 21 calls for immediate proper management of mountain resources and socio-economic development of the inhabitants of mountain areas (United Nations 1992).

1.1.3 ENVIRONMENTAL DEGRADATION OF THE DIENG MOUNTAINS

The same chain of environmental catastrophes explained in section 1.1.2 also occurs in the Dieng Mountains and their surrounding area (Figure 1.1). Located in Central Java Province, Indonesia, some parts of the mountain range still bear forests in relatively good condition. However, the montane forests that face the Dieng Plateau from the southern and southeastern slopes suffer from degradation caused by population pressure. Forest fires, illegal logging, forest looting, followed by land encroachment and shifting cultivation have become regular events in this area, replacing the mature montane forests with young secondary vegetations. Consequently, the landscape of the Dieng Mountains was, and still is, covered by mosaics of young secondary vegetation. Although the local farmers apparently understood the advantage of terracing, they did not interpret this advantage in relation to the preservation of top soil, but only with regard to soil water-storage capacity (Palte 1988). Exacerbated by heavy rainfall, this poor farming practice has resulted in the occurrence of pesticide pollution, a high level of erosion, sedimentation of lakes and reservoirs, landslides, and mud floods. These phenomena in turn pose an additional threat to the functioning of the Dieng Mountains ecosystem and its valuable biodiversity, also because, as Chapin et al. (2000) have made clear, the change in species diversity will influence the resilience and resistance of ecosystems to environmental changes.
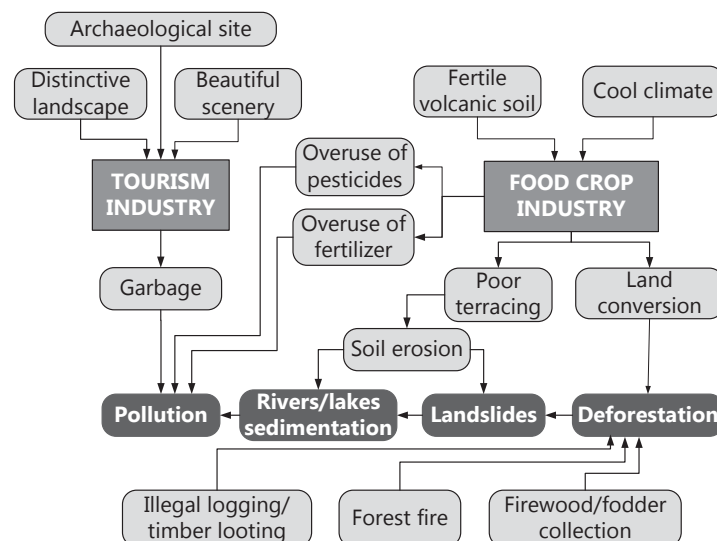

Figure 1.1. Causes and effects of ecosystem degradation in the Dieng Mountains: causes (light shade), main industries responsible for causes (medium shade), effects (dark shade).

1.1.4 GAPS AND SHORTFALLS IN INDONESIA'S BIODIVERSITY AND ENVIRONMENTAL PRESERVATION EFFORTS

Because it is a nation that is highly dependent on its abundant natural resources to support its development, there have been many efforts by the Indonesian government to preserve and maintain the sustainability of these national assets, including the ratification of the United Nations Convention on Biological Diversity (UNCBD) in 1994. Under the UNCBD scheme, the Indonesian government developed the Indonesian Biodiversity Strategy and Action Plan (IBSAP) 2003-2020, a continuation of the Biodiversity Action Plan for Indonesia made in 1993, to manage its natural resources using a bottom-up, participatory approach. In its 4th National Report on the Convention on Biological Diversity (Indonesian Ministry of Environment 2009), it is stated that the goal of IBSAP is "to achieve fair and balance of roles and interests of Indonesian society, as well as to reduce conflict potentials among all relevant sectors in a conducive, synergic, responsible, accountable manner in the sustainable use and conservation of biodiversity". The programs run under IBSAP are in line with the scheme set forth in the UNCBD, including biodiversity inventory in Indonesia and preservation of the forest ecosystem as a part of climate change adaptation efforts.

Despite those well-designed programs, there are still gaps in the planning: forest and land fires are not yet taken into account in IBSAP programs. Further on, according to the monitoring results, the implementation of IBSAP has not yet fully accomplished the goal of conserving Indonesia's biodiversity. The obstacles mentioned in the 4th National Report include: the lack of supporting data and information to be used as a basis for planning and implementation, limited available funding sources to support the program implementation in the field, limited supporting facilities to reach remote areas (hence the programs failed to reach the target groups), and lack of public participation in the program implementation.

1.2 Research Importance

1.2.1 CURRENT KNOWLEDGE ON THE DIENG MOUNTAINS AREA

The Dieng Mountains have been an object of fascination for both scientists and naturalists because of their unique landscape and geological formation, rich biological diversity, and historical value. Records and written reports of the area have existed since the Dutch colonialism, dating back as early as the beginning of the 19th century. A comprehensive description of the Dieng Mountains landscape can be found in the report by Junghuhn (1912). There have also been a number of studies on the Dieng Mountains' ecosystem and landscape, agrosystem, wildlife, and past vegetation (e.g. Doornewaard 1991; Nijman and van Balen 1998; Nijman and Setiawan 2001; Pudjoarinto and Cushing 2001; Smiet 1990, 1992). These studies have been the most prominent ones with regard to Java uplands, including the Dieng Mountains ecosystem and its wildlife. However, these studies provide neither comprehensive

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data on the ecological condition of the Dieng Mountains, nor do they specifically address issues about it, and it is possible that most of their information is outdated.

1.2.2 THE FUTURE OF THE DIENG MOUNTAINS ECOSYSTEM: MANAGEMENT AND RECOVERY EFFORTS

The importance of mountain ecosystems, like the one found in the Dieng Mountains, in providing a wide range of goods and services, especially in supplying freshwater to their adjacent areas and maintaining biodiversity, stresses the need to sustainably manage mountain regions to secure the future of humanity (Convention on Biological Diversity, 2011). The idea of gazetting the Dieng Mountains as a conservation area has been proposed since 1998 and a strategic plan was in development for this purpose. Nijman and Setiawan (2001) conducted studies involving the collection of biodiversity data to support the justification of the conservation area's establishment. However, it is not clear whether a fully-formed proposal has ever been submitted, let alone come to fruition.

Fears stemming from the frequent natural catastrophes that occur in the Dieng Mountains area and which threaten the local economy have compelled the district governments that have jurisdiction over the Dieng Mountains to develop recovery programs. In Wonosobo District, an official task force called *Tim Kerja Pemulihan Dieng* (the Dieng Recovery Working Group) was formed in 2007 to run *Program Pemulihan Dieng* (the Dieng Recovery Program, DRP). The program, whose goal is to recover the functions of the Dieng Mountains protection area without compromising the economic, socio-cultural, and environmental interests of the local people, works in a participatory way, involving government officials, non-governmental organizations, the private sector, and academics. Several activities have been carried out to prepare the involved parties for a full implementation of the project, including training in participatory planning for village representatives from Kejajar Subdistrict, meetings with the trainees to discuss recent environmental issues, and small-scale reforestations in several villages. The latest activity published in the DRP's official website was held in March 2010, in which it was stated that the program will be integrated in the District Wonosobo's development plan for the period 2011-2015 (Program Pemulihan Dieng 2011). No further progress was reported as of this manuscript's writing.

1.2.3 CONTRIBUTIONS TO THE DIENG MOUNTAINS ECOSYSTEM IMPROVEMENT

The results of this research will provide an overview of the present condition of the Dieng Mountains ecosystem and help to fill in the information gaps left by previous studies. This research will provide the policymakers with knowledge of the current state of the Dieng Mountains, allowing them to develop an effective program with reasonable goals and take appropriate actions in their effort to improve the ecological conditions of the Dieng Mountains. The decision to focus on plant, mammalian, and bird communities was made for two reasons: they represent important parts of the Dieng Mountains ecosystem, and prominent species within the ecosystem will help to

grab public attention and increase public awareness of the ongoing environmental degradation in the Dieng Mountains.

1.3 Problem Description and Aims

1.3.1 PROBLEM DESCRIPTION

Extending over an area of 22,500 ha, the Dieng Plateau's landscape is covered mainly with agricultural lands and dense settlements concentrated in the middle of the plateau. The ancient temples scattered within the plateau, remnants of a lost Hindu civilization, now serve as a large tourist attraction for the region. The intensive commercial cropping system practiced since the early-20th century in this area greatly accelerated the erosion process (Doornewaard 1991), the impact of which can still be felt in the present. The planting season runs all year round, relying on the heavy application of fertilizer and pesticides to gain high yields. Shifting cultivation and illegal logging leaves behind plenty of abandoned lands, fragmenting the landscape, and endangering the survival of wildlife native to the area. The abandoned lands eventually regenerate into regrowth forests, which can be found all over the mountain slopes, most notably on land that has actually been designated as protection forest.

Regrowth forests have become the major vegetation type surrounding the Dieng Plateau, and with current farming practices, the trend of their formation indicates that they will persist into the future. So far, little has been done to deal with regrowth forests in the Dieng Mountains, and their value in terms of ecosystem functioning and biodiversity preservation has gone relatively unstudied. Bowen et al. (2007) mentioned the importance of management and recovery of biodiversity in regrowth forests to facilitate landscape restoration and the recovery of faunal communities in fragmented agricultural landscapes. Since Dieng montane forests are known to harbor many endemic and rare wildlife species (Nijman and van Balen 1998; Nijman and Setiawan 2001; Wikramanayake et al. 2002), it is important to understand how wildlife species in this area cope with habitat change.

1.3.2 AIMS

This research is an attempt to examine the impact of land use change resulting from human-induced disturbances to the local flora and fauna. Impacts on the native vegetation were studied by comparing the structure, floristic composition, and species diversity of the secondary vegetation of the Dieng Mountains. We chose two animal taxonomic groups, birds and mammals, to assess the value of the existing types of habitat formed by different developmental stages of regrowth as a wildlife habitat. We estimated the species diversity and density of bird populations in these habitat types to examine the use of secondary vegetation by the avifauna community. We recorded mammalian species richness and the use of the different habitat types

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by various mammal species to determine the value of secondary vegetation as a habitat for the mammal community in the Dieng Mountains.

1.3.3 RESEARCH QUESTIONS

The following are the main questions to be answered in this research:

- What are the most prominent types of secondary vegetation identified in the study area?
- What are the structure and floristic composition of the different types of secondary vegetation, and how do they differ? What is the plant species diversity of each vegetation type, and how do they differ? What can be deduced from the analyses with regard to the impact of land use change to the native vegetation?
- Which species of birds are found and what is their abundance in each vegetation type?
- Which species of mammals are found and how do they use different vegetation types? Is there an indication of preference or avoidance towards particular vegetation types?
- What can be concluded regarding the value of each vegetation type for mammalian and bird communities?