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# Drivers and consequences of land use patterns in a developing country rural community

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ABSTRACT

Deforestation has caused degradation of ecosystem services around the world, undermining soil stability, biodiversity, protection from natural extreme events, and long-term food security. The purpose of this study is to examine closely the interrelationships of these factors in a coastal area on the diversity-rich island of Mindoro, the Philippines, where poverty is both a driver and a result of complex ecological problems. Soil and vegetation assessments of sites with differing land use intensities were compared, and narrative interviews were conducted to augment the overview derived from the quantitative analyses. Forested and agricultural slopes have a history of exploitation by the indigenous minority and show distinct signs of erosion. Species diversity on intensely cultivated, degraded and *Imperata cylindrica*-dominated slash-and-burn fallow sites is low. Secondary forests with shallow soils are able to recover when left untouched for several years. Floodplain soils are productive and farmed extensively with rice and coconut by the growing Tagalog majority. Population pressure and a gradient of political and economic power between the dominant Tagalog and the indigenous (Mangyans) hinder efforts at poverty alleviation. The resulting economic needs drive illegal logging and intensification of agriculture which, if continued, will lead to further decline of forest and soil resources, endangering livelihood and biodiversity.



## 1. Introduction

### 1.1. Philippine forest cover

The Philippines is one of the most biologically diverse countries in the world (Brown and Diesmos, 2009). It was almost entirely covered with dense, evergreen forests when the Spanish arrived in the 16th century. Since then, forest cover has decreased from the initial 90–18% at present, only one sixth of which may be considered primary forest (Stenberg and Siriwardana, 2007; Suarez and Sajise, 2010). A common explanation for this dramatic decrease is large-scale logging as a reaction to growing national and, more importantly, global demand for high-quality lumber throughout the centuries. Philippine forests feature high concentrations of commercially valuable trees, namely the members of the dipterocarp family like *Terminalia microcarpa* or *Shorea contorta*, as well as other non-dipterocarp hardwood evergreens such as *Vitex parviflora* or *Pterocarpus indicus* (Bankoff, 2007). The logging would be followed by the expansion of mostly small-scale swidden agriculture into cleared areas, preventing natural succession through constant cultivation (Kummer and Turner, 1994; Suarez and Sajise, 2010).

Even after the establishment of selective logging, logging bans, annual allowable cuts and protected areas in the second half of the 20th century (Liu et al., 1993), corrupt politicians with connections to the commercial agricultural and forestry sector have been authorizing generous logging concessions, under-invoicing lumber exports, and helping to smuggle logs (Kummer, 1991; Kummer and Turner, 1994). Findings of other scholars suggest the highest deforestation rates took place during the period 1965–1986 (Bankoff, 2007) when many poor urban families migrated to forested or recently logged uplands in search of more secure forms of livelihood. The rural poor at the same time had to yield favorable lands to corruption-aided, capital-intensive commercial agriculture, joining the urban migrants to settle on accessible slopes of public domain and engage in subsistence agriculture (Kummer, 1991; Amacher et al., 1998).

The problems caused by deforestation include negative impacts on soil stability, biodiversity, flood retention capacity, local

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livelihood and regional economies. Due to the high rates of endemism in the Philippines (>70% for plants; see also Brown and Diesmos, 2009), deforestation leads to a worldwide extinction of plant species as well as their faunal associates (Suarez and Sajise, 2010). It is generally recognized that deforestation is not homogenously distributed within the country, but influenced by factors such as the accessibility and proximity to roads, forest fragmentation (Liu et al., 1993), corruption, geographic distance to the central government, as well as by poverty, war and the migration patterns resulting from them (Kummer, 1991; Amacher et al., 1998; Bankoff, 2007).

### 1.2. Slash-and-burn agriculture

The role of slash-and-burn or swidden agriculture (Kleinman et al., 1994; local term, "kaingin") as a major contributor to the disappearance of forests is highly controversial. The practice has been criticized (Neyra-Cabatac et al., 2012) for causing poor crop yields, soil degradation and erosion, as well as forest destruction (Kleinman et al., 1994). Due to this popular perception (Dressler and Pulhin, 2010), swidden farming is outlawed in virtually every South East Asian country (Neyra-Cabatac et al., 2012). Instead, national programs to promote sedentary farming, resettling schemes and media campaigns are carried out (Dressler and Pulhin, 2010).

Kummer (1991) states that there is no hard evidence pointing to either kaingin or commercial logging as the major driver of deforestation. They should rather be regarded as immediate causes, while the primary causes are to be found in the social inequities of an elitist society concentrating wealth at the expense of the disadvantaged, in unequal land distribution, population growth, failing macropolicies and the lack of employment alternatives.

Swidden farming in the Philippines is carried out in varying intensities. Several researchers distinguish between "traditional/integral" and "newly adopted/incipient" forms (Kleinman et al., 1994; Dressler and Pulhin, 2010). They argue that shifting cultivation practiced by indigenous people for centuries on sparsely inhabited land is performed following principles of sustainability deeply rooted in their traditions (Kleinman et al., 1994; Neyra-Cabatac et al., 2012). Neyra-Cabatac et al. (2012) studied indigenous agroforestry in the southern Philippines and found that traditional farmers allow sufficient fallow periods to regain fertility by planting legumes to assimilate atmospheric nitrogen, avoid very steep slopes, and leave some mature trees on a farm patch to aid soil stabilization. A relatively great variety of crops form a mosaic that is more resilient towards ecological stresses (e.g., pests, droughts) than monocultures.

However, when free land becomes scarce due to an influx of lowlanders, swiddeners are forced to decrease fallow periods to non-sustainable levels, sacrificing soil fertility. When grasses like *Imperata cylindrica* (locally known as "cogon") eventually colonize these areas, they are likely to prevent forest succession (Suarez and Sajise, 2010). The marginalization of integral swiddeners is criticized as responsible for the loss of the traditional knowledge that is needed to carry out non-destructive swidden techniques (Dressler and Pulhin, 2010).

### 1.3. The study area

The rural barangay of Udalo (ca. 13°26′13.97″N; 120°50′37.62″E) is situated in the municipality of Abra de Ilog, province of Occidental Mindoro, the Philippines. It has a population of about 3700 (National Statistics Office, unpublished) occupying a total land area of 10,725 ha (Municipal Government of Abra de Ilog [MGADI], 2008). There are several small settlements and two perennial rivers within its boundaries. Udalo River and Camurong River are separated by a slightly elevated ridge and discharge into the Verde Island Passage between the islands of Luzon and Mindoro. The terrain rises rapidly to more than one thousand meters above sea level leaving little space for agriculture. The narrow meadows are planted mostly with rice and coconut. The coastline of Udalo features a particularly diverse coral reef (pers. obs.).

The ethnic group known as the Tagalogs (largely immigrants) constitute the majority of the population and enjoy standard (though erratic) amenities like electricity, television and mobile phone service. Sewage and waste disposal are virtually unregulated. Water from wells and rivers for domestic use is untreated. There are several elementary schools and one high school in the study area (Municipal Government of Abra de Ilog [MGADI], 2008).

The minority ethnic (also the indigenous) group are the Mangyans, whose villages, on the other hand, consist of loosely arranged bamboo huts with grass roofs, with virtually no modern amenities. Most are subsistence farmers. As in many parts of the world, there is a long history of oppression and exploitation of Mindoro's indigenous peoples by migrants (cf. Helbling, 1993; Helbling, 1996; Andres, 2006).

Personal observations suggest that Mangyans are the poorest members of Mindoro's society. They are underrepresented in schools and public services and have the least access to medical treatment. Many lack official registration. Accordingly, their interests cannot be addressed. Alcoholism and gambling are common and cases of human trafficking have been reported.

### 1.4. Ecological problems

The mountain tops and slopes near the coast are almost bare and, according to locals, have been that way for at least 40 years. Cattle grazing, cogon cultivation, charcoal production and former small-scale talc mining also explain lack of forest cover. Many slopes are steep and annual rainfall is high. These conditions result in topsoil erosion and landslide susceptibility. Consequences are increased river loads that can cause sediment deposition on coral reefs in adjacent coastal waters (pers. obs.), and heightened flooding risk. Water retention capacity is also diminished (cf. Municipal Government of Abra de Ilog (MGADI), 2008).

The region is frequented by extreme meteorological and geological phenomena such as flash floods, earthquakes, strong cyclones and liquefaction (MGADI, 2008) which further undermine ecological resilience and limit options for sustainable livelihood (cf. Adger, 2000; Millennium Ecosystem Assessment, 2005).

## 2. Material and methods

Continuous fieldwork was conducted during the period May–August 2013 to capture a vital window after the previous rainy season, and before the significant onset of the next rainy season. Hence, the sample size was restricted. This limitation was, however, offset by the direct comparability of the different kinds of habitats sampled because they were all characterized within the same season, eliminating excessive variability that may have been caused by heavy precipitation and flooding, for example.

### 2.1. Soil identification and vegetation analyses

To detect signs of or susceptibility to soil erosion and accumulation due to different land uses, eight soil analyses were performed. A transect of four excavation pits from top to foot of an intensively cultivated, steep hillside was complemented by two soil analyses in secondary forests of different age, and one