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Identifying characteristics of households affected by deforestation in their fuelwood and non-timber forest product collections: Case study in Kampong Thom Province, Cambodia

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ABSTRACT

This study explored characteristics of households affected by deforestation in their fuelwood and non-timber forest product (NTFP) collections in Kampong Thom Province, Kingdom of Cambodia, where tropical lowland forests are decreasing in size owing mainly to agribusiness development and farming. Deforested areas were delineated by satellite image interpretation of forest cover change. A questionnaire survey was conducted for 161 households in six villages within three districts having varying degrees of forest cover changes per capita over a period of 5 years. Generalized linear mixed models were used to analyze characteristics of households affected by deforestation in their fuelwood and NTFP collections. The characteristics vary with the collection activity examined, either fuelwood or NTFP collection. We revealed that deforestation notably affects villagers whose non-forest fuelwood sources are scarce. People who collected fuelwood in forests after deforestation are more likely to be affected if the remaining forest area per capita near their village is less. In contrast, for NTFP collection, the size of the deforested area per capita near villages is more important than that of the remaining forest area, particularly to those who depend on NTFP collection as one of their main livelihood activities before deforestation. In contrast with much of the literature that has stated that the poor depend more on NTFPs, our results show that the relationship between household wealth and NTFP dependence was more than a simple negative correlation; i.e., the local people's material wealth was not a strong determinant in our NTFP model. The importance of stakeholder analysis and consultation with local residents in impact assessments and natural resource management involving land-use changes has been progressively acknowledged in the academic literature. In this context, we argue that it is essential to identify potentially affected groups among local residents in terms of their fuelwood and NTFP collections in a short-term period widely distributed at the provincial level. The combination of our findings, method applied and existing demographic survey networks in Cambodia provides an approach of identifying the affected residents in a transparent manner.

1. Background and objectives

Livelihoods of residents in the rural tropics often depend on ecosystem services provided by forests. In particular, fuelwood is used for cooking and energy sources, whereas non-timber forest products (NTFPs), such as foods, traditional medicines and construction materials, are used for subsistence and income sources across developing countries (e.g., Tabuti, 2007; Vedeld et al., 2007;

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Narain et al., 2007; McElwee, 2010; Ektvedt, 2011; Kabubo-Mariara, 2013; Matsika et al., 2013; FAO, 2014). However, tropical forests are rapidly diminishing because of developments such as agribusiness, subsistence agriculture and timber extraction (Hosonuma et al., 2012).

These developments have been addressed by forest protection initiatives in developing countries (e.g., Blom et al., 2010; Kanowski et al., 2011; Matthews et al., 2014). However, environmental and/or social assessments of such land-use change development projects and policies are generally hampered by financial, personnel or other constraints in those countries (Duffy, 2004; Trethanya and Perera, 2008; Pasgaard, 2013).

In evaluating services that forests and surrounding environments provide in a holistic manner, and in assessing impacts of the aforesaid developments, the need to gather socioeconomic and cultural information in addition to biophysical information is increasingly recognized (Sheil et al., 2006; Cowling et al., 2008; Raymond et al., 2009). The importance of stakeholder analysis and consultation with potential stakeholders has also been progressively acknowledged for effective forest management. In particular, it is essential to understand the perspectives of those who depend on forests for their daily needs and to feed the perspectives into forest management and conservation strategies so that they are tailored to a local context (Hamilton et al., 2000; Larson 2004; Batterbury and Fernando, 2006; Scheyvens et al., 2007; Reed, 2008; Vodouhê et al., 2010; Ehara et al., 2013).

However, in forest conservation, goals, outcomes and considered impacts are often determined by particular stakeholders such as policymakers, scientists and donors, and local people's viewpoints are often neglected (Sheil et al., 2006; Sheil and Salim, 2012; Schusser, 2013). Similarly, in natural resource management projects, a biased stakeholder analysis can lead to uneven empowerment or further marginalization of certain groups, which may cause conflicts among them and produce undesired outcomes, and such projects are prone to failure (Reed et al., 2009; Robards et al., 2010).

In this context, it is crucial to identify those most affected by deforestation through stakeholder analysis. Having achieved this, project proponents could raise the confidence of and develop support from local people toward forest development or conservation.

Studies have explored the characteristics of local people who are likely to be affected by actual deforestation in terms of fuelwood and/or NTFP collections (e.g., Tadesse et al., 2014; Tiwari, 2008; Mandondo et al., 2013; Julia and White, 2012). Such studies generally have long-term assessment time frames, such as time frames of a few decades, whereas few apply shorter time frames (e.g., Schoneveld et al., 2011). Moreover, few attempts have been made to purposively examine the relationships of the characteristics with the degree of forest-cover change in their range of livelihood activities. Therefore, the objectives of this study are to identify characteristics of households affected by deforestation in their fuelwood and NTFP collections within 5 years, particularly paying attention to the change in forest area around their villages, and to determine policy implications for forest development and conservation at a provincial level.

NTFPs require biotic and abiotic conditions, such as pollinators, dispersers, light, nutrients, and water availability, to grow; maintaining these conditions is fundamental for sustainable NTFP collection (Ticktin and Shackleton, 2011). Thus, we first hypothesized that larger size of a deforested area around villages, associated with increased human access to the area that can alter biotic and abiotic conditions around the villages, results in greater deforestation impact on NTFP collection for the villagers. Second, in contrast to NTFPs, which grow under particular living conditions, we hypothesized that the size of the deforested area has less effect on fuelwood collection, because collection is feasible in any vegetation area where sufficient fuelwood sources remain (e.g., Top et al., 2004a,b; Ndayambaje et al., 2013). We examined instead whether the size of the remaining forest area around the villages with interaction of forest-fuelwood collection affected their fuelwood availability. Third, we tested the effects of differences in local people's livelihood strategies, material wealth, and experience of forest clearance on people's vulnerability to the impacts (see Section 2.5 for more detailed analysis).

2. Materials and methods

2.1. Study site

We selected the Kingdom of Cambodia as the country in our case study, first because fuelwood is the main energy source for cooking and heating in the household sector of Cambodia (National Institute of Statistics, 2013). The cited report states that more than 90% of the population living in rural areas relies on fuelwood for cooking and only 0.1% and 3.7% on kerosene and liquefied petroleum gas, respectively. Second, about 75% of the rural population of the country depends on NTFPs for their living needs, and these products contribute to the diversification of income and employment opportunities (Ministry of Agriculture, Forestry and Fisheries, 2010). Fuelwood collection on state lands (both forested and non-forested) is allowed for consumption by the collectors (Top et al., 2004b), and NTFP collection and sales are permitted with some conditions (Boissière et al., 2013).

Although all forest areas are owned by the state, forest exploitation is permitted under various concessions, such as forest concessions for timber production, economic land concessions for the agribusiness of private companies within a maximum area of 10,000 ha, and social land concessions that provide residential areas and agricultural land for the poor (Schmidt and Theilade, 2010). However, there is little forest management (particularly in remote areas) because of a lack of personnel and equipment and poor coordination between related ministries and agencies. This has resulted in rampant forest conversion and illegal logging (Ministry of Agriculture, Forestry and Fisheries, 2010). During 2006–2010, the national forest cover declined from 59% to 57%, corresponding to a loss of 366,993 ha of forest (Forestry Administration Cambodia, 2011).

The study site is on the eastern side of a provincial town in Kampong Thom Province (hereafter, KT Province, which has an area of 12,447 km^2), the Kingdom of Cambodia (105°00′0″E–105°45′0″E, 12°20′0″N–13°10′0″N) (Fig. 1). We selected this area because forest cover there has been rapidly decreasing since the 2000s (Matsuura et al., 2013) and people there depend on the forests as sources of fuelwood and NTFPs. In KT Province, the annual average temperature and rainfall are 27 °C and 1300–1900 mm, respectively, with there being a dry season from November through February (Araki et al., 2007; Kabeya et al., 2008). About half of the KT provincial area is forested, with four dominant forest types, evergreen, deciduous, mixed (evergreen and deciduous), and inundated forest. Most of the forest lies in lowlands or on plateaus less than 100 m above mean sea level. In our study area, about 90% of forests are evergreen or mixed.

KT Province is one of the provinces with high poverty in Cambodia (JICA, 2010). The province population was 690,414 in 2013 and its growth rate during 2008–2013 was 1.79% (National Institute of Statistics, 2013). Many villages are located along National Road 6 and the Stung Sen River (Fig. 1).

According to a study on fuelwood availability in KT Province by Top et al. (2004b), all sampled households used fuelwood for cooking. The fuelwood was from litter or trees with maximum diameter at breast height of 30 cm, which grew particularly in