# Paper Tigers, Fences-&-Fines or Co-Management?

## Community conservation agreements in Indonesia's Lore Lindu National Park

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Abstract

Protected areas may be established and maintained at the expense of local communities ('fences & fines'), although attempts to block local land use can be fruitless ('paper tigers'). Innovation in protected area policy has led to the involvement of communities in protected-area management ('co-management'). This paper aims to predict and study the emergence of such negotiated agreements to share the management of as well as the benefits from forest. First, we develop a conceptual framework for understanding roles of co-management interventions. Second, we bring to our derived hypotheses unique panel data collected from a co-management policy implemented in Lore Lindu National Park, Indonesia. The results broadly support our model predictions, although there is mixed evidence in some cases, possibly due to the fact that our relatively rough data proxies often correlate with several model parameters.

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Keywords

forest, protected area, park, community, property right, Indonesia

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## 1. Introduction

Protected areas will continue to be an important instrument for conservation of biodiversity and other environmental services. In developing countries, they may be established and maintained at the expense of local communities (Kiss 1990; Swanson and Barbier 1992; Tisdell 1995). Such top-down management may be called 'fences & fines', highlighting exclusion. Yet sometimes the reality of protected areas is that attempts to block local land use are fruitless; then such parks are mere 'paper tigers'. Conflicts over natural resources and property rights are among the reasons why such protected areas fail to conserve (see Albers and Ferraro 2007; Bulte and Engel 2007).[1]

We emphasize that these two possibilities do not exhaust the set of outcomes. There has been much innovation in protected area policy to involve local communities in protected-area management.[2] Typically, locals with long-standing claims to forest resources have been integrated into management plans alongside the development of new income streams such as from eco-tourism.[3] Such collaborative management, or 'co-management', involves protected-area authorities negotiating with local people to share both the management of and the benefits from forest resources (Fisher 1995; Borrini-Fayerabend 2000). For example, locals might take responsibility for forest protection and management in exchange for receiving rights to forest products and other benefits.[4] By defining property rights to natural resource use for local people, co-management schemes attempt to create club goods and enable people to benefit from the direct use values of resources, e.g. harvesting non-timber forest products (NTFP) (see Baland and Platteau 2000; Knox and Meinzen-Dick 2001; Bulte and

[1] In developing countries, over 70% of natural forests are owned (de jure) by the state (White and Martin 2002). Issues of property rights and enforcement of exclusion are relevant for immense areas. Scherr et al. (2002) estimate that around 25% of forests are now owned or controlled in some way by resource-dependent communities.

[2] Trends towards community ownership of forest, for example, are said to follow from a number of rationales: evidence of successful cases of commons managemen (Ostrom 1990); clear failures of state management, perahps due to high costs of monitoring and enforcement; shrinking government budgets; social equity concerns; and perhaps linked to some or all of these, promotion by international donors.

[3] See, for example, Sims (2009) on rising consumption and decreasing poverty near parks in Thailand.

[4] Such projects are sometimes known as 'integrated conservation and development projects' (ICDPs). These involve varying levels of local participation from sharing the benefits from wildlife-related activities to community-based management where local people are trained to manage (see Brandon and Wells 1992). In parallel, governments in developing countries have sometimes implemented devolution reforms and policies that allow for the greater involvement of local communities or user groups in managing natural resources (Meinzen-Dick et al. 1999). Thus, there is also an element of enabling local participation in natural resource management by creating a new class of 'stakeholders'.

Engel 2007).[5] The objective of such projects is two-fold: to ensure the protection of natural resources in situ; and, at the same time, to provide local stakeholders with alternative income sources from the sustainable utilization of resources.[6] Projects are many and varied and can be found in countries around the world (Edmonds 2002).

Given typically weak though highly variable *de jure* property rights and more generally typically relatively weak governance structures within developing countries, it can be difficult to know to what to compare in terms of outcomes of co-management to see whether or not they have been effective. Even the definition of success varies across settings and across stakeholder groups within a given setting, although protection of natural resources and sustainable local livelihoods are often central to the discussion.

Evaluating effectiveness by inspecting just the forest and other outcomes of co-management can easily be confounded by the determinants of where it succeeds. If co-management only arises when a protected area authority in fact has the ability to 'fence & fine' to keep pristine forest, then co-management may be highly correlated with but not responsible for maintenance of forest. In the opposite extreme, positive livelihood outcomes could correlate with co-management if this institution arises in cases in which protection is more like a 'paper tiger' and consumption is unbounded.

Along those lines, this paper aims to predict and study the emergence of such negotiated agreements to share the management of as well as the benefits from forest. First, we develop a conceptual framework for understanding roles of co-management interventions. Second, we bring to our derived hypotheses unique panel data collected from a co-management policy implemented in Lore Lindu National Park, Indonesia.

Starting on the conceptual side, we develop a simple game-theoretic model of an interaction between a protected area authority and a local community residing on periphery of a park. A critical point is that property rights over the park's natural resources are endogenous. The model is adapted from previous work by Engel, López

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[5] That does not mean it is always expected to 'work'. Larson and Ribot 2004 discuss preconditions for effective co-management including secure and well-defined property rights, transfer of appropriate and sufficient powers to communities, and downwardly accountable and representative local institutions.

[6] Naturally these objective are not always achieves. Bulte and Engel (2007) note that devolution has in cases been more a transfer of responsibilities than a transfer of rights, for instance an,outsourcing of costs while maintaining control. Thus community rights may still be weakly defined and only rarely enforced while governments maintains control through extensive bureaucratic procedures as well as the withholding of information and a lack of capacity building. Empirical study is critical for evaluation.

and Palmer (2006) and Engel and Lopez (2008), which consider the interaction between resource-dependent communities and resource-extraction firms in a context of weak property rights. There the firm—by commercially extracting the resources—limits the community from benefiting from the standing forest. In this case, the park—by preventing extraction—limits the community from exploiting park resources.

We consider *de facto* property rights as an outcome of the interaction between the park and community. In contrast, previous studies of co-management assume that property rights over protected area resources are exogenous. For example, Barrett and Arcese (1998) and Skonhoft and Solstad (1998; 2008) consider the effects of a co-management intervention on illegal hunting and wildlife conservation. In these two studies either the local households or the park agency, respectively in each paper, has full control over the wildlife stock. Another example is a model by Johannesen and Skonhoft (2005) which assumes that both the park agency and local people control wildlife. Still rights are exogenous but now actors are strategically interdependent.

Gjertsen and Barratt (2004) offer a different sort of example. They develop a contracting model of conservation design, in which specific conservation tasks such as financing and management are efficiently allocated between a community and a government according to the prevailing biophysical, economic and socio-political conditions. Co-management is one outcome of the model, although all of the possible outcomes can be interpreted as conservation outcomes. Here, unlike in our model, property rights are still given exogenously. Also, again in contrast with our model, there is no potential for a non-conservation outcome, e.g. in which a park fails to have any influence on the forest outcomes (as in the 'paper tiger' scenario we describe).

Muller and Albers' (2004) more general model features a developing country protected-area manager interacting with local households in various market settings. This model has significant commonalities with ours, despite their different emphases. Two important differences stand out. First, our model assumes no external, third-party enforcement; instead, everything needs to be self-enforced. Second, we believe that the corner solutions in the model are important options to consider for explaining an observed reality. This expansion of explicit foci matters for some differences in result.

In our model there are three outcomes. First, complete forest protection where the park claims *de facto* property rights, leading to a 'Fences-&-Fines Park'. Second, a situation of open access, where property rights are *de facto* claimed by communities which implies 'Paper Tiger Parks'. Thirdly, a negotiated or co-management outcome, between the park and the community, in which the park authorities effectively claim *de facto* rights but the relevant local communities still benefit from direct-use values from the resource in exchange for taking on management responsibilities in the park.

These predictions are examined for Lore Lindu National Park in Sulawesi, Indonesia. In the wake of decentralization in Indonesia's natural resource sectors at the end of the 1990s, and local demand for a share of resource rents, the head of Lore Lindu pioneered a new policy known as 'Community Conservation Agreement' (*Kesepakatan Konservasi Masyarakat*, or KKM). Promoted by NGOs and part of the new co-management strategy, these were agreements negotiated between community representatives and the park authorities that attempted to strike a balance between nature conservation and the communities' development needs (Mappatoba 2004).

Within a KKM, communities benefit from the use of park resources, e.g. via limited timber extraction and the collection of NTFP such as plant fibres and rattan. They are contracted to manage areas that approximate long-standing resource claims. Our empirical results involve two comparisons. First, we compare community means of proxies for our model's parameters to examine consistency with the predictions from the conflict part of our model determining which actor has *de facto* rights (meaning the park can impose a Fences & Fines outcome if it has rights or the locals can make the park a Paper Tiger). Second, we compare the means of proxies for subgroups of the villages that in fact have KKMs, to examine consistency with predictions about transfers to community within the agreements. The results broadly support our model predictions, although there is mixed evidence in some cases, possibly due to the fact that our relatively rough data proxies often correlate with several model parameters.

The remainder of the paper is as follows. Section 2 presents our model of the bargaining process, in which de facto property rights arise based on other parameters, and derives hypotheses concerning the kinds of agreements that one can expect to see. Section 3 provides background on the setting including the facts of KKM agreements. Section 4 then provides our comparison of the unique KKM data set with the model-based hypotheses. Finally, Section 5 discusses and points to potential further work.

## 2. Model

We present a game-theoretic model of community-park interaction in a context of weak property rights. This model is adapted from Engel, López and Palmer

(2006) and Engel and López (2008). The model integrates conflict and bargaining theories. Below, the conflict-and-rights component of the model is discussed first.

### 2.1 Conflict Determines Endogenous Property Rights

In Engel, López and Palmer (2006), *de facto* property rights are modeled as the outcome of a war of attrition between a commercial actor (e.g., a logging company) and a resource owner (the community). We adapt their model to co-management of protected areas. Our two actors are ‘park authority’ (or *P* or ‘Park’) and ‘Community’ (*C*). The resource is ‘forest’. In Engel et al. (2006), the possibility of bargaining is developed in a context of resource exploitation, logging. In our context, bargaining occurs over the environmental benefits of ‘forest conservation’ (see next sub-section).

Park has *de jure* property rights over the forest but may only be able to enforce these weakly, e.g. due to a lack of funds and manpower to monitor large remote areas. These rights are challenged by local people with long-standing claims to the resources in the park. In many developing countries, devolution and decentralization of rights to natural resources have often strengthened customary claims to the forest.

Each of the actors could obtain *de facto* forest-control rights. Community may unilaterally exploit the forest if it has the power to win a war of attrition. Park may prevent that if it is more powerful. If Park can effectively enforce its legal property rights, it can exclude Community from using park resources. If, on the other hand, Community is able to win a potential conflict, i.e. if Park cannot effectively present exploitation, then bargaining between Community and Park may take place over a co-management agreement to share conservation benefits. For simplicity, we assume that each actor is risk neutral and has perfect information about the other’s parameters.[7].

Let $v(\overline{L}-L)$ denote the per-period environmental benefits[8] from conservation given forest extraction *L*. The initial level of forest is given as $\overline{L}$ while $\tilde{L}$ denotes

[7] This implies that the actor that would lose the conflict withdraws immediately. With imperfect information, actual conflict is possible, but the outcome will generally depend on the same parameters listed here (see Burton (2004) for a related model with imperfect information).

[8] While the environmental benefits from protecting standing forest in a park can be interpreted as nonuse values, say for biodiversity and other non-local externalities, the extent of benefits optimized by park authorities will depend on the eventual beneficiaries. If the park is, for example, established and run by a central government, then the beneficiaries will be those in the national society. In this case global public goods such as the carbon sequestration function of biomass may assume less importance than say scenic beauty.

forest extraction without any enforcement by Park. Forest extraction under a co-management arrangement (modeled in section 2.2 below) is denoted by $\hat{L}$. We will show below that $\bar{L} > \tilde{L} > \hat{L}$. For no forest extraction, i.e. $L = 0$, environmental benefits are given by $\bar{v} = v(\bar{L})$. Environmental benefits in the absence of Park enforcement are $\tilde{v} = v(\bar{L} - \tilde{L})$. Those under a co-management arrangement are $\hat{v} = v(\bar{L} - \hat{L})$. We assume that $v$ is increasing and concave in $\bar{L} - L$, $(v' > 0, v'' < 0)$.

Community attempts to break park rules through, for example, collection of fuelwood, hunting, small-scale logging and the harvesting of rattan. These yield direct use values (and require little capital investment).[9] Let $b(L)$ denote the per-period net benefits of forest exploitation to Community, e.g. from timber and rattan sales (which reduce the forest level by *L)*. Under a co-management agreement, the Community's benefits of forest exploitation are given by $\hat{b} = b(\hat{L})$, while in the case of zero Park enforcement C's benefits are denoted $\tilde{b} = b(\tilde{L})$. We assume that $b$ is increasing and concave in $L$, $(b' > 0, b'' < 0)$. The discount rate of actor $i$ is denoted $r^i$ ($i \in \{C, P\}$).

In general, a conflict game is won by the party able to stay in the potential conflict longer. The conflict game between Community and Park is seen in Figure 1. In each period, Community can attempt to exploit park resources by investing effort in extraction of forest products. Park, in turn, can attempt to enforce control over the forest by setting up monitoring and enforcement to prevent resource extraction. If the Park loses this conflict and withdraws, then a situation arises that we characterize as a 'Paper Tiger' (PT) park. If, on the other hand, Community loses the conflict, Park is able to enforce a 'Fences and Fines' (FF) situation. As will be shown in section 2.2, in this case Park may eventually opt for a co-management agreement instead. We assume that a co-management agreement is only an option when Park wins a potential conflict, not when the community can claim *de facto* property rights over the forest. This assumption is made because any such co-management agreement would not be enforceable by the Park in the case where the Park cannot win a potential conflict.[10]

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[9] The Community may also consider ecological services from the standing forest (e.g., erosion prevention, water retention) as well as non-use values (e.g., the cultural value of living near a forest). For simplicity, we assume a zero value of non-use values to the Community.

[10] To be enforceable in this case, a co-management agreement would have to be in the form of a conditional payment. This would require a multi-period model that is beyond the scope of this paper. Moreover, such conditional payments were not observed in our field setting in Indonesia. They may,

**FIGURE 1 HERE**

With perfect information, both actors can perfectly predict conflict outcomes. Hence, the actor who would lose the conflict withdraws immediately.[11] A PT outcome has no monitoring or enforcement and high Community forest extraction while a FF outcome has no extraction by Community and high monitoring/enforcement by Park. Staying in conflict one more period means that both actors incur costs and benefits. Park incurs the costs of the monitoring and enforcement, *K*, and receives per-period conservation benefit $v(\bar{L})$. For Community, there is a cost of attempting to withdraw forest products, denoted as *e(L)*, which is given by the value of the effort (opportunity cost of time) spent in the attempt. Without Park enforcement, Community will chose $\tilde{L}$ to maximize per-period net benefits of extraction, i.e., to satisfy

$$b'(\tilde{L}) = e'(\tilde{L}) . \tag{1}$$

If Community wins the conflict it obtains the present value of the stream of forest benefits, $\frac{\tilde{b}}{r^C}$. Three cases can be distinguished. First, where $\tilde{e} > \frac{\tilde{b}}{r^C}$ the Community never enters into a conflict because the cost of extraction exceeds the value of exploiting park resources forever. So long as the Park's net benefits from forest conservation remain positive, i.e., $\frac{\bar{v}}{r^P} > K$, Park will always win the conflict and will establish *de facto* property rights over the forest. Second, if $\tilde{e} < \tilde{b}$, Community will always extract because the benefits from doing so exceed the costs in even the same period. Third, for $\tilde{b} > \tilde{e} > \frac{\tilde{b}}{r^C}$, or equivalently, $\tilde{e} r^C > \tilde{b} > \tilde{e}$, the conflict is won by the actor that can stay in conflict longer. The conflict outcome in this case is obtained by computing for each actor the maximum length of time that this actor can stay in conflict while still receiving a non-negative expected payoff. Let these be denoted by $t^C$ and $t^P$ for the community and the Park, respectively. Setting $t^C > (<)\ t^P$, the condition for the Community (respectively the Park) to win the conflict is obtained.

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however, be relevant in other settings and thus, allowing for this possibility would be an interesting extension to our model.

[11] To model actual conflict in terms of imperfect enforcement and ongoing violations of Park rules by the Community would require introducing imperfect information. This would make the model considerably more complex and is beyond the scope of this paper.

In analogy to Engel et al. (2006), it can be said that Park is more likely to win the conflict (thus obtaining de facto property rights over the forest, i.e., being able to enforce a fences-and-fines situation) when the following conditions prevail:

- the conservation benefits from the protected park resources ($\bar{v}$) are high (e.g. in an area of national importance due to large biodiversity values or one which could potentially receive payments for environmental services)
- Park's costs ($K$) of monitoring and enforcing a FF situation are low
- Community's extraction costs ($\tilde{e}$) are high
- Community's benefits from forest extraction are low (e.g., low dependence on forest for livelihoods or less valuable rattan or timber are harvested),
- Park's discount rate is low and/or the Community's discount rate is high.

These results are very intuitive. An actor is likely to be able to stay in conflict longer the higher are his benefits and the lower are his costs from doing so. Moreover, since benefits are received over time while fighting costs are immediate, each actor is likely to stay in conflict longer the lower his discount rate.

If Park wins the conflict game, it can enforce a FF situation. In this case Park payoffs per period are given by $\bar{v} - K$, while the community's benefits from the park are zero. However, in this case, Park and Community may negotiate a co-management agreement (see section 2.2 below) where Park delegates monitoring and enforcement of park rules to Community and allows some limited extraction of park resources.

If the Community wins the conflict game, a PT situation results. In this case, the community's per-period net benefits from forest extraction are $\tilde{b} - \tilde{e}$, while Park receives reduced conservation benefits of $\tilde{v}$. As explained in footnote (10), in this case a co-management agreement would not be enforceable in our simple model without conditional periodic payments. Table 1 shows the payoff matrix for all three possible outcomes. The case of a co-management agreement is discussed next.

**TABLE 1 HERE**

## 2.2 Community-Park Negotiation Under De Facto Park Rights

Here we focus on cases where the Park is able to self-enforce property rights, imposing FF, yet bargaining may lead to a co-management agreement. We refer to a co-management agreement as KKM, using terminology from our Indonesian example presented in the following section. The negotiated transfer from Park to Community under an agreement is denoted $\Pi^C$, while $s$ denotes Community's costs of setting up an internal monitoring and sanctioning system that substitutes for Park's efforts.

An important argument for co-management agreements or, more generally, decentralized natural resource management, is that it may be less costly for local communities to monitor and enforce resource use rules because they can rely on local knowledge and traditional monitoring and enforcement mechanisms (e.g., ostracism). Thus, it may well be that $s<K$, inducing an incentive for Park authorities to consider a co-management agreement, in which it trades reduced monitoring and enforcement costs (by devolving management responsibilities to the Community) for some (limited) resource extraction rights (denoted by forest extraction level $\hat{L}>0$).

Following Engel et al. (2006), we model negotiation over a co-management agreement between the Park and the Community as Nash bargaining. As shown in Muthoo (1999), the Nash bargaining solution implies that each actor receives his reservation utility and a share of the remainder of the cake that is inversely related to his bargaining power, denoted here by $\tau^i$ for actor $i$. In our model, Community payoffs under the co-management agreement are given by $b(\hat{L})-e(\hat{L})-s+\Pi^C$. Community's reservation utility is zero, as we focus on when Park would win a potential conflict. Park's reservation utility is $v(\overline{L})-K$. Total benefits to divide under a co-management agreement are $v(\overline{L}-\hat{L})+b(\hat{L})-e(\hat{L})-s$. Thus, the Nash bargaining solution is given by

$$b(\hat{L})-e(\hat{L})-s+\Pi^C=0+\tau\left|v(\overline{L}-\hat{L})+b(\hat{L})-e(\hat{L})-s-0-\left(v(\overline{L})-K\right)\right|$$

$$\Rightarrow \Pi^C=\tau\left|K-(v(\overline{L})-v(\overline{L}-\hat{L}))\right|-(1-\tau)\left|b(\hat{L})-e(\hat{L})-s\right| \qquad (2)$$

Furthermore, note negotiations over a co-management agreement will succeed only if the size of the cake exceeds the sum of both actors' reservation utility, i.e., if

$$v(\overline{L}-\hat{L})+b(\hat{L})-e(\hat{L})-s-\left(v(\overline{L})-K\right)>0. \qquad (3)$$

Thus, a KKM is more likely to result when the loss in the conservation benefits from forest extraction ($\overline{v}-\hat{v}$) and/or the Community's costs of monitoring and enforcement ($s$) are low, or when Community's net benefits from resource extraction ($\hat{b}-\hat{e}$) and/or the Park's costs of enforcing a Fences-and-Fines outcome ($K$) are relatively high.

The allowed forest extraction level under a co-management agreement, $\hat{L}$, would be chosen by the two parties in order to maximize the 'size of the cake'.

$$\max_{\hat{L}} v(\overline{L}-\hat{L})+b(\hat{L})-e(\hat{L})-s \Rightarrow v'(\overline{L}-\hat{L})+e'(\hat{L})=b'(\hat{L}) \qquad (4)$$

Comparing conditions (1) and (4) yields that $0 < \hat{L} < \tilde{L}$, i.e. forest extraction will be lower under a co-management agreement than under a PT situation. This is so because a co-management agreement takes the reduction in conservation benefits into account. The negotiated permitted extraction level $\hat{L}$ is larger the less sensitive *v* is to the area conserved, i.e. the less the Park loses from permitting some extraction, and the more sensitive *b-e* is to extraction levels, i.e. the more net gains from the first extraction.

Intuitively, starting from the default outcome of FF, the total 'agreement cake' to divide in negotiations for co-management are the net benefits from allowing some level of extraction while reducing the monitoring and enforcement effort by Park from what was required to enforce FF. As the marginal enforcement costs to fully prevent extraction could be high and the marginal benefits of the first units of extraction could also be high, agreement may be desirable. To agree, then, would allow Community to capture limited direct use value (timber, NTFP, etc). In return, the Community would be taking on limited management and enforcement responsibilities for the Park.

There may also be a transfer involved. Examining (2) shows that the transfer to the Community ($\Pi^c$) rises with community bargaining power ($\tau^c$), Park costs of enforcement (K), and Community enforcement costs (s). It falls with the conservation benefits lost under a KKM ($\bar{v} - \hat{v}$) and Community net benefits from extraction ($\hat{b} - \hat{e}$).

That transfer, $\Pi^C$, may be positive or negative. Coasian thinking could have Community pay Park to desert the FF result that it has the (de facto) right to impose. That would be a negative transfer. If it is negative, Park may keep part of the benefits of extraction, e.g. by retaining a portion of the NTFP collected by the Community.

In the model, $\Pi^C < 0$ if $\tau\left|K - (v(\bar{L}) - v(\bar{L} - \hat{L}))\right| < (1-\tau)\left|b(\hat{L}) - e(\hat{L}) - s\right|$. This is more likely for small $K$, i.e. monitoring costs are less of the 'agreement cake', or for $v(\bar{L}) - v(\bar{L} - \hat{L})$ or $b(\hat{L}) - e(\hat{L})$ large, i.e. Community really wants to extract some of the natural resources, or $s$ is small. While not observed in Indonesia, a transfer from Community to Park occurs in other settings, such as India's Joint Forest Management programme and a Participatory Forest Management programme in Ethiopia.[12]

### 2.3 Hypotheses

The model results derived in sections 2.1 and 2.2 can be summarized in four sets of hypotheses, which we will test with data from Indonesia in section 4.

[12] For example, see Behera and Engel (2006) and Rustagi, Kosfeld and Engel (2009).

*Set A (from conflict game)*

| | | **Park has *de facto* rights (yielding FF or a KKM)** | **Community has *de facto* rights (yielding PT, never KKM)** |
|---|---|---|---|
| | $\bar{v}$ | High | Low |
| | $K$ | Low | High |
| | $\tilde{e}$ | High | Low |
| | $\tilde{b}$ | Low | High |
| | $r^C$ | High | Low |
| | $r^P$ | Low | High |

Empirically, as we have attempted below in Section 4, these predictions from the model can be examined for our case by comparing a group of observations consisting of both FF and KKM with the group of PT for those parameters listed in the table.

*Set B (feasibility of bargaining outcome, from condition (3))*

| Parameters \ Outcomes | | FF | KKM |
|---|---|---|---|
| | $\hat{b}-\hat{e}$ | Relatively lower | Relatively higher |
| | K | Relatively lower | Relatively higher |
| | $S$ | Relatively higher | Relatively lower |
| | $\bar{v}-\hat{v}$ | Relatively higher | Relatively lower |

These predictions from the model can be examined by comparing the means of these parameters across the group of observed FF and the group of observed KKM.

*Set C (size of co-management transfers to the Community ($\Pi^C$), from equation (2))*

| Parameters \ Outcomes | | KKM transfer to Community is greater if: |
|---|---|---|
| | $\tau^C$ | Higher |
| | $K$ | Higher |
| | $\bar{v}-\hat{v}$ | Lower |
| | $\hat{b}$ | Lower |

| | | |
|---|---|---|
| | *S* | Higher |

These predictions from the model can be examined by comparing listed parameters between subgroups of the group of observed KKM, specifically those communities receiving agricultural/development benefits in agreements and those which did not.

*Set D (degree of forest use permitted under KKM, from (4)):* $\hat{L}$ is larger the less sensitive *v* is to forest area conserved and the more sensitive net benefits from forest extraction (*b-e)* are to extraction levels. This prediction from the model requires proxies for the functions' sensitivity measures. We do not yet include those below.

## 3. The Indonesian Park Setting

We present background about Lore Lindu National Park in Indonesia, which includes information on the surveys and methods used to gather data in the area. Following that, we provide some context for better understanding of the negotiated KKM agreements along with some basic statistics related to the observed agreements.

### 3.1 Lore Lindu National Park (LLNP)

LLNP covers a mountainous area of over 200,000 ha dominated by primary and secondary forest, in the province of Central Sulawesi. The region is renowned for its unique biodiversity. LLNP is an identified core area for protection of the Wallacea biodiversity hotspot (Myers et al., 2000; Achard et al., 2002; Lepers et al., 2005) with over 200 bird species observed, 77 endemic to Sulawesi (Waltert et al., 2004; 2005).

By combining three protected areas, established between 1973 and 1981, Indonesia's government officially founded LLNP in 1993 (Mappatoba and Birner, 2004). From 1993 onwards, customary land has been converted into Park territory, with a few villages moved out of the park to its borders (Mappotoba, 2004). Despite decentralization of broad swathes of government after the fall of Suharto in 1998, all of the National Parks are still run by central government (specifically the Ministry of Forestry) from Jakarta. Central government holds de jure property rights to all natural resources, with strict rules prohibiting village forest use in the Park. Land use rights in local communities tend to be based on traditional *adat* rights (village customary law).

There are 60 villages located close to the borders of LLNP, with another seven concentrated in two enclaves inside the Park's borders (see Figure 2). The provincial capital, Palu, is close to the northern end of LLNP, with relatively good roads linking it to many of the 60 villages. Agriculture is the primary source of income for most households with paddy rice as the principal food crop and cocoa and coffee identified as the most important cash crops (Maertens et al., 2006).[13] Agricultural expansion has been identified as one of primary drivers of deforestation in LLNP (Maertens, 2003).

**FIGURE 2 HERE**

Beginning in 1999, and on the initiative of the head of the LLNP at that time, Community Conservation Agreements (*Kesepakatan Konservasi Masyarakat* (KKM)) were established as a strategy for Park authorities and local communities to jointly co-manage forest inside Park borders. Mediated by local and international NGOs, KKM were negotiated to resolve conflicts between communities' needs and conservation's demands (Mappatoba, 2004). Overall, the aim of the KKM are to overcome the major threats to LLNP, i.e. forest conversion inside the Park for agricultural land, rattan extraction, logging, hunting of protected endemic animals, and the collection of the eggs of the protected maleo bird (ANZDEC 1997). Long-standing community claims to Park forest resources were recognized in exchange for communities undertaking responsibilities towards Park protection and management. While de jure property rights to forest land stayed with the Indonesian government, limited forest use rights for communities were tacitly institutionalized[14] in the co-management agreements.

As part of a long-running interdisciplinary research programme known as Stability of Rainforest Margins in Indonesia (STORMA),[15] 80 out of a total of 119 villages in the Lore Lindu region were surveyed using a stratified random sampling method in 2001 (Zeller et al. 2002). Data were collected on community characteristics including demography, household livelihoods, land use and social institutions. In 2006 and 2007, this survey was repeated with the same sample, although the number of communities surveyed dropped to 72 due to funding and time constraints.[16] One major difference was the inclusion of detailed questions on the KKM in the 2006-07

[13] Average community-level production that goes to market for the most important crops grown are: rice = 29.5%; corn = 68%; coffee = 73.6%; cocoa = 92%.

[14] Via an interpretation of Indonesia's 1999 Forestry Law made by the then head of LLNP (Mappatoba, 2004). The law gave substantial decision-making powers to local governments, and formalized community use rights to forest resources (Palmer and Engel, 2007).

[15] STORMA is a collaborative research programme between Indonesian and German universities - the Agricultural Institute Bogor (Bogor, Java), Tadulako University (Palu, Sulawesi), University of Kassel and Georg-August-University Goettingen. Since 2000, research has focused on processes and factors of the stability and dynamics of rainforest margins.

[16] All those dropped from the survey in 2006 were ones located furthest away from the Park, with little or no dependence on Park resources and no land claims within the borders of LLNP.

survey. Before then, it was not known which villages had negotiated agreements with the exception of six villages surveyed previously by Mappatoba (2004). Moreover, remote sensing data on land use in Lore Lindu were collected by STORMA for 2001-02 and 2006-07. Based on 30 by 30 m pixels, these data are divided over a number of land use classes including ‘broadleaved (closed) forest’ and ‘mosaic’ (degraded forest and agriculture), alongside a number of agricultural land uses. Finally, a map of community land claims was overlaid on a land use map using data collected in a comprehensive five-year mapping project undertaken between 1998 and 2003.[17]

### 3.2 KKMs (community co-management agreements negotiated in LLNP)

A total of 50 communities claim forest inside LLNP. All claim forest outside LLNP as well. Of these, 28 negotiated co-management agreements with the Park, with local and/or international NGOs as facilitators. These NGOs have differing policy objectives (Mappatoba and Birner, 2002). The first KKM was piloted in 1998 by a local NGO known as the Free Earth Foundation (YTM) that emphasized indigenous land- and forest-use rights. YTM is involved in facilitating agreements in a further six communities -- of which four were facilitated in collaboration with other NGOs. Another local NGO, JAMBATA, has a more environmental focus and strong links to the international development NGO CARE. It also works in a relatively small number of communities in this area, in this case six total of which three were co-facilitated.

The NGO responsible for facilitating the majority of agreements is the Nature Conservancy (TNC), an international conservation NGO. It has worked with LLNP on conservation management plans since 1992. The 21 agreements promoted by TNC, and sometimes co-facilitated with JAMBATA or YTM, had a high level of detail on resource-use regulations and were adapted to a village’s conditions. Negotiations were typically concluded and agreements acknowledged by the Park within the same year.

In 34 villages (69 percent), the NGO involved in the agreement had worked in the community before the KKM. Communities often initiated negotiations for a KKM (in 64 percent of cases) and around half of KKM communities claimed to have been concerned about forest degradation prior to the KKM. Eleven communities stated that wanting to claim forest inside the LLNP was one motivation for negotiating a KKM.

[17] Coordinated by the provincial authorities of Central Sulawesi, the project was funded by the Asian Development Bank, and known as CSIADCP (Central Sulawesi Area Development and Conservation Project). The project had over US$30 million set aside for community development, buffer zone management, project management and infra-structural improvements (See Mappatoba, 2004).

The typical KKM process involved facilitators and communities working together to map and to plan as well as to draft the KKM. Mapping was undertaken in 24 (86 percent) of cases. The park authority was usually in attendance during this process; local government was present in fewer cases. By 2006, 24 KKM (86 percent) had been formally recognized by the park authorities. In general, KKM agreements allowed communities the 'right' to remain settled within LLNP (for those yet to be resettled outside) and the authority to manage natural resources in LLNP (following traditional village institutions and customary use rights) in exchange for community commitment to implement a forest management plan and to enforce this effectively (either with existing indigenous institutions or with new ones created for the job). Traditional forest rights were agreed on in 22 KKM (79 percent), while a permission to remain in a community's current location was agreed in 16 KKM (57 percent). Agricultural assistance was agreed upon in 13 cases (46 percent). The most common rules agreed on in KKM include: limits on the amount of timber to be harvested (24 cases or 56 percent); restrictions on forest conversion to agriculture (18, 64 percent); restrictions on plantation development (16, 57 percent); restrictions on the harvesting, use an sale of rattan (16, 57 percent); and, restrictions on the use and sale of timber (14, 50 percent). All of the communities had or put an enforcement system in place with 'regular' checks of forest areas undertaken in 15 cases (54 percent).

## 4. Empirics

Our model considered three institutional outcomes. Ranking them from worst to best from Community's perspective in terms of being unlimited in their land uses, we discussed a Fences-&-Fines result in which the Park blocks forest extraction, then a KKM outcome in which the Park could block forest extraction but negotiates a deal with Community to allow some extraction and save on monitoring and enforcement, and then a Paper Tiger result in which Park is unable to block, i.e. Community wins.

The great strength of our data is the observation and description of the KKMs. An immediate challenge, however, is how to distinguish non-KKM institutions. Even if all local actors were confident they could identify the Fences-&-Fines (FF) relative to the Paper Tiger (PT) settings, on the basis of their own experiences or a short chat with residents of other communities, we do not observe this distinction in the data.

At the risk of sweeping in all sorts of heterogeneities, a possibility to which we will remain attentive below, for the purposes of examining our predictions from the model concerning the emergence of these three institutions we will use the observed rates of deforestation to separate non-KKM communities. Thus if the change in forest from 2001 to 2006 is positive for a non-KKM observation we assign the label FF. If it is negative, we assign PT. Table 2 below conveys that there are significant differences across communities labeled in this way. It is of potential interest that the KKMs are right in the middle, with rates of deforestation statistically significantly above the lower-clearing (or 'FF') communities and below the higher-clearing (or 'PT') ones.

**TABLE 2 HERE**

4.1 Hypotheses A – Who Wins De Facto Rights?

Recall the conflict model that determines which actor will be able to impose one of the extreme outcomes, i.e. full conservation or full extraction. Not surprisingly, the higher $v$ and/or the lower $b$ the more likely is FF, since the Park has more to gain and the Community has less to lose from exclusion. The lower is $K$, i.e. Park's cost of excluding Community, the more likely is FF. Since the conflict is a war of attrition, the higher the Community discount rate the more likely is FF. Finally, the higher the Community's extraction costs $e$, the more likely is FF. We look for these in the data.

Table 3 compares the means for our proxies for $v$, i.e. the conservation benefits of the park, $K$, i.e. the Park's cost of enforcement, $b$, the Community gains from extraction, $e$, the Community's cost of extracting Park resources, and finally $r^C$, the Community discount rate. The rationale underlying the proxies used throughout this section can be seen in the Appendix.

**TABLE 3 HERE**

To begin, we consider the conservation benefits of the park, $v$. The single proxy we have for this parameter appears to be significant and consistent with model predictions. The more likely a community is in close proximity to an important bird-watching site, the higher the conservation benefits. The likelihood of proximity to a bird-watching site is 0.44 for FF and KKM communities, which is significantly higher than that for PT communities. Birdwatchers, however, not only pay fees to Park in order to access these sites but they also spend money in and around the villages located close to these sites. This would imply lower community benefits from reducing forest for those communities situated near bird-watching sites, which is borne out by our results.

Regarding Park enforcement costs (*K*), we use proxies corresponding to the proportion of Community land that can be characterised as hilly terrain, i.e. over 20° (from the GIS data), the mean elevation of community territory above sea level (also from GIS data) and proximity to a park ranger office (from survey data). The results seem to suggest that flatter terrain and greater likelihood of proximity to park rangers' offices likely lowers the cost.[18] These are both consistent with more power to exclude, i.e. FF and KM outcomes, with significant differences between the two columns. Community benefits from reducing forest may also be expected to be higher where terrain is flatter. However, our results seem to indicate that this might not be the case. One reason might be that communities cultivate agriculture, particularly rice, both on slopes as well as in flatter areas (see Maertens et al., 2006).

Considering the proxies for *b*, i.e. Community gains from extraction, there are five that have significant differences between the values in the two columns, hence supporting the model, and three more that have a consistent direction of effect. When a higher share of the village migrates, there is relatively less value in extracting from the Community perspective, giving the Park a greater chance of claiming de facto rights. Also, the two prices, for rice and coffee, are lower in those places where it seems Park could exclude. That is consistent, signalling a lower *b*. Prices of rice land as expected where there might be a high value attached to forest conversion to agriculture, although the opposite result is seen for prices of land for other agriculture. Neither, it should be noted, is significantly different between the two columns. Higher prices of both timber and rattan are also found where the community could exclude with the former being significantly different.[19] Significantly greater food shortages are found in communities with higher expected benefits from reducing forest for food production. High livelihood dependence on timber is reflected where the Community could exclude, although this difference is not significant.[20]

[18] Also, it seems that being within reach of Palu and the provincial government matters. Communities with FF/KKM and PT outcomes are, on average, 79 and 110km away from Palu, respectively. This difference in significant.

[19] However, note that greater distance to market (from community to Palu) implies lower crop prices. Prices for corn, coffee and cocoa are all significantly inversely correlated to distance, with corn and cocoa, as are those for rattan and timber prices. Rice prices do not follow this pattern, which might reflect the role of rice as a subsistence crop with prices determined by factors other than distance to market.

[20] While the numbers of those households who are livelihood-dependent on timber harvesting are relatively small, these are included in our analysis due to having a potentially large influence on the small deforestation rates observed in our sample.

Next we consider the community's expected (opportunity) cost of extraction, *e*. Differences between the two columns for two proxies, the proportion of households with off-farm wage labour and the proportion of children between the ages of 13 and 18, are not significant. That said, the relative sizes of the values in the two columns are as expected: opportunity costs might be higher where we find more households in off-wage labour and where more children that would otherwise accompany families to work in fields and forest are to be found in school.

In general, we expect that those communities with higher discount rates prefer present to future consumption and hence, are in some sense 'poorer' than those with lower rates. Robust proxies for Community discount rate are difficult to isolate and analyse due to evidence of correlation among these. Credit is a relatively reliable proxy for community discount rate, although it should be stressed that there is also evidence of bias in the distribution of credit among communities in our sample. For instance, poorer communities might be exactly those places targeted by a government credit programme. In fact, communities located close to the provincial capital are more likely to have a government credit programme in place than those located further out of the government's reach, which would likely lead to a FF result.[21] But, on the other hand, we might not expect these places to be poorer than those that are unable to access credit markets.

### 4.2 Hypotheses B – Default Fences vs. Negotiated Comanagement

Moving to set B, the comparison is between communities that have negotiated a KKM and ones where the park excludes, FF. Note again that these are the communities where the Park has won de facto property rights, i.e. under the conflict game. Thus, strict 'Community wins', i.e. PT cases are not considered here.

From Table 4 and beginning with our sole proxy for *v*, the conservation benefits of the park, we find that community proximity to a bird-watching area, while showing no significant difference between the two columns appears to be higher where the park might exclude altogether (FF).

**TABLE 4 HERE**

[21] Access to government credit and other credit with distance of community from Palu are both significantly correlated (1% level). Thus, the further away from Palu and outlying areas, the less likely a community has access to any kind of credit, which indicates that credit is not randomly distributed among villages.

Regarding the park's cost of monitoring and enforcement, *K*, the amount of hilly land appears to be higher where we might expect to find lower costs. The other two proxies appear to have relative values as predicted, in particular for mean elevation: land that is closer to sea level appears to be cheaper for the park to monitor hence resulting in an outcome where the park can exclude the community altogether under a FF strategy. However, this result should be treated with caution given the result for elevation in Set A.

Considering proxies for *b* we find, in contrast to the results for the conflict game, that our results are not consistent with theory. Only three proxies, food shortages, the proportion of community territory inside the park and rattan price, have values that are consistent with expectations. In particular, a significantly higher proportion of community forest is found in the park where a negotiated co-management agreement is the outcome. For all the other proxies, similar high values are found where we might expect a lower *b*, i.e. where FF is the outcome.

The purpose of the statistical tests for Set B, in contrast to Set A, is to highlight differences between communities that remain in a FF situation and those in which a KKM emerged. Recalling that one of the key features of a KKM is that the Park devolves some monitoring responsibilities (costs) to the Community in exchange for limited forest use, the community's cost of setting up an internal monitoring system, *s*, is of particular interest for Set B. Overall, we find that proxies for *s* strongly support the theoretical predictions. Thus, consistent with much of the collective action literature, we find that smaller and significantly more homogenous communities can self-monitor at lower cost. Moreover, we find KKM outcomes where there is a significantly lower likelihood of previous conflict among households in the community, irrespective of whether they are native or not. Land is also an important factor with significantly lower proportions of landless villagers and those that have sold all land in previous years in KKM communities compared to FF communities. The former are the ones that are more able to self-monitor at lower cost.

### 4.3 Hypotheses C – Transfers Under Co-management

Like Table 3 and 4, Table 5 compares means for proxies. However, in this case we are comparing not KKM versus non-KKM communities, as in Table 3, or KKM versus FF communities as in Table 4, but instead subsets of the group of communities with KKMs in order to examine whether the data line up with the model's predictions about when a negotiated agreement will involve transfers.

In principle, such a transfer could be either positive (flowing to Community) or negative (flowing to Park). We observe existence or lack of flows to Community, though we observe both promises negotiated in KKMs and service actually delivered.

For a proxy variable for $\Pi^C$ , i.e. the model transfers, we use a dummy for promised and delivered agricultural development benefits. Table 5 examines means by KKM subset for *v*, the conservation benefits of the park, *K*, the Park's cost of enforcement, *b,* the Community gains from extraction, *s*, the Community's cost of monitoring and internal sanction, and finally $\tau$, the Community's relative bargaining power. We discuss values below. Note that the subset of communities being studied is now only a sample of 28, which is divided according to (i) whether or not the Community received a promise of agricultural development as part of its KKM, and (ii) whether or not the Community actually received any agricultural benefits as a result of participating in a KKM. It should not be assumed that those receiving benefits received promises originally. Of the 11 that received benefits, four did not say that these were originally promised. Five of the 13 that were promised benefits had not received anything at the time of the survey.

**TABLE 5 HERE**

As in Table 3 and 4, here we find mixed evidence in this preliminary effort to align detailed observations about the terms of the KKM co-management agreements with a range of characterization of village setting. For each model parameter, many empirical proxies do not differ by group, while some significant differences support the model. First, our results for *K* and *v* are not convincing, although some directions of effect are as expected.

For *b*, we find that a transfer is made to the community where there is significantly less community forest in the park and with significantly fewer households dependent on timber for livelihoods. This last result is reversed when rattan is considered as a livelihood strategy as well.

Regarding *s*, we find that transfers occur where there is a significantly higher incidence of conflict between the community and other communities but an opposite result when considering intra-community conflict. Moreover, where the community was more likely to have been formerly part of another community and with more unequal land distribution, transfers were likely to have been promised. Both of these differences are significance and in line with theory.

Finally, transfers are expected to occur where community bargaining power $\tau$, is found to be higher. According to the data, transfers occur where communities are more likely to have previous knowledge of other communities moving out of the park due to LLNP enforcing a strict FF regime under the Suharto government. Armed with this knowledge, communities are expected to be a stronger position to negotiate higher levels of rents from the KKM. Moreover, bargaining power is higher where the NGO is known to be concerned with forest degradation and where the community is less likely to make an explicit claim to forest inside the park. Knowing that the NGO is keen to prevent degradation and/or not showing an early hand in laying claim to forest early on in KKM negotiations might strengthen the community's bargaining power in extracting rents. All these variables are found to be significant. Other variables show weaker links to the theory.

## 5. Discussion

- at least theoretically we can explain variation in KKM terms as the result of a negotiation process that depends on bargaining power and fallbacks.

- can also explain positive and negative transfers within agreement about co-management, although Indonesian data does not allow testing this because only positive transfers are observed. Possible extension to India since there is a wide variation in transfers between states.

- comparison of the model's predictions with a unique data set on KKMs in the Lore Lindu National Park in Sulawesi, Indonesia is just starting (with some tables and preliminary analyses above); concerning which of our three institutions arise finds some consistencies per key parameters

- one interesting policy implication from within the current model is that KKMs are not good for improving conservation, because they arise only when the alternative institution is effective enforcement by Park; KKMs are rather then just a means of reducing monitoring costs for the Park.

- emergence of KKM involve underlying de facto rights and thus fallback positions; in our model, KKM emerges only if Park has potential to enforce rights; in reality, imperfect information may result in KKMs being attempted in areas where community can win a potential conflict yet our model implies that KKMs are unlikely to be effective in this situation, unless they can be implemented conditional on performance; that requires periodic transfers and monitoring of forest outcomes (Participatory Forest management program in Ethiopia actually has both:  state management was not working before program was introduced (PT))

- an extension of our empirical work with imperfect information in mind could look for where negotiated rules are seriously violated

- this and other cases suggest as suggested above within a footnote that we may need to include the option of KKMs in PT settings

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**Figures and tables**

*Figure 1: Conflict game between Community and Park*

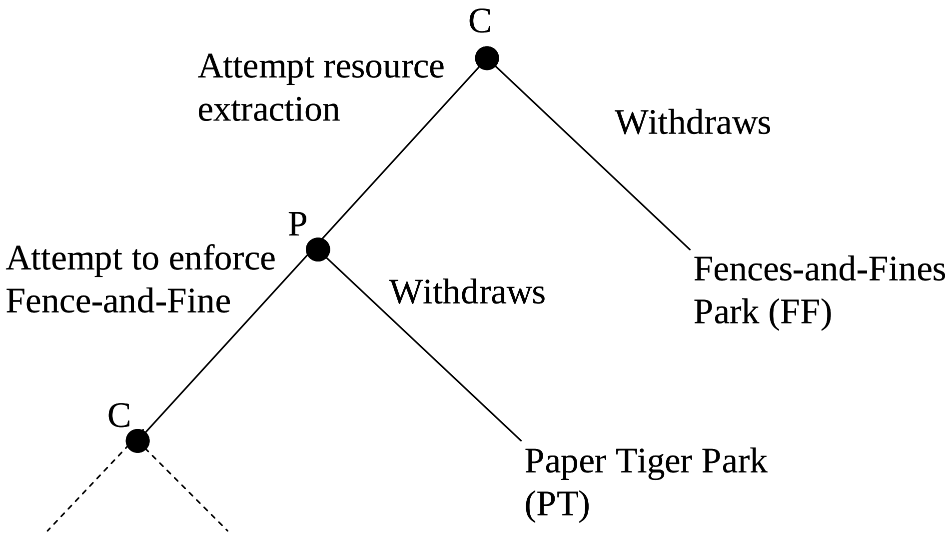
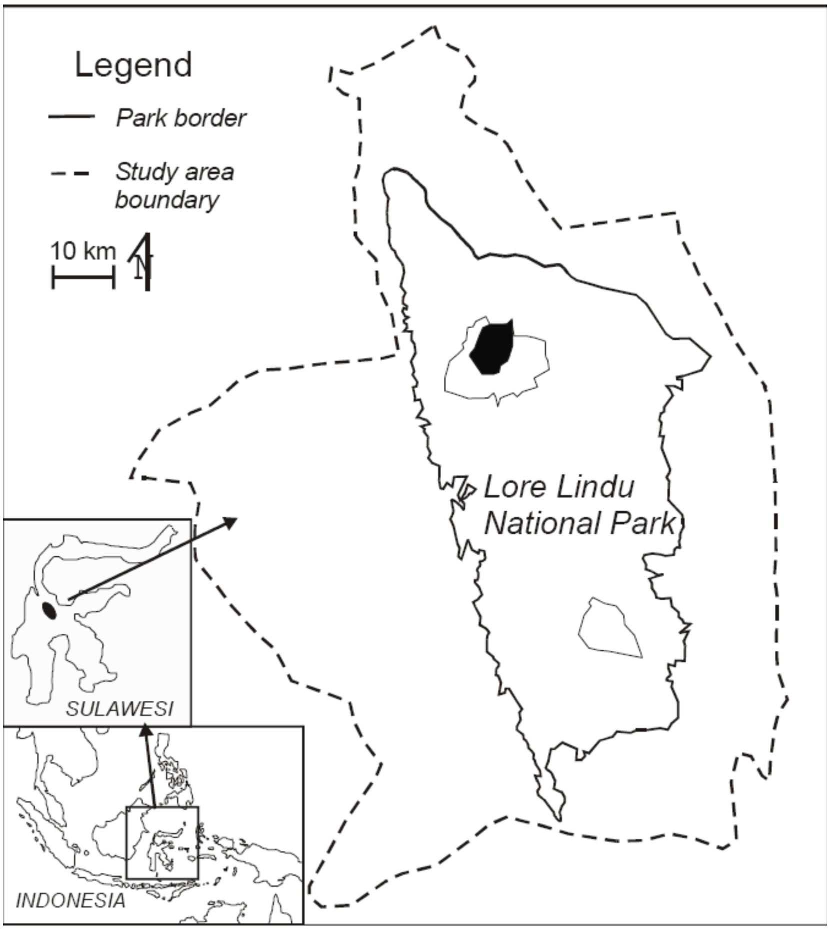


*Figure 2: Map of the study area*




Source: Stability of Rainforest Margins in Indonesia (STORMA)

Note: The dark area denotes a water body within one of the enclaves.

**<u>TABLE 1:</u> Payoff Matrix for Model Outcomes**

| | Payoff to P | Payoff to C |
|---|---|---|
| IF PARK (P) WINS POTENTIAL CONFLICT: | | |
| *Fences-&-Fines (FF)* (high enforcement, no extraction tolerated) | $v(\overline{L}) - K$ | 0 |
| *Co-management agreement (KKM)* (Park saves on monitoring/enforcement by devolving these tasks to Community in return for some Community extraction & possibly a transfer (it could be + or -) | $v(\overline{L} - \hat{L}) - \Pi^C$ | $b(\hat{L}) - e(\hat{L}) - s + \Pi^C$ |
| IF COMMUNITY (C) WINS POTENTIAL CONFLICT: | | |
| *Paper Tiger park (PT)* | $v(\overline{L} - \tilde{L})$ | $b(\tilde{L}) - e(\tilde{L})$ |
| *KKM* – is not enforceable here unless transfer can be conditional on performance | | |

**<u>TABLE 2:</u> Labelling Communities**

<u>Average rates of change in forest in KKM and non-KKM outcomes (labels applied)</u>

| | 'FF' | KKM | 'PT' |
|---|---|---|---|
| Number of communities | 11 | 28 | 11 |
| *L* (rate of change in forest cover within the park, 2001-06) | 7.268*** | -0.257** | -6.360*** |

Note: Significant of differences between means are indicated in KKM column for KKM versus. PT, in FF column for KKM versus FF, and in PT column for PT versus FF: *** = 0.01; ** = 0.05; * = 0.1

**TABLE 3: Comparing Means Set A -- FF & KKM versus PT**

(using independent samples t-tests to indicate significance)

(yellow highlighting for consistency with hypotheses)

| | FF & KKM (39) | PT (11) |
|---|---|---|
| ***v(L)* = conservation benefits of park** | *expect v higher* | *expect v lower* |
| Neighbouring a prime bird watching area | 0.44* | 0.18 |
| ***K* = park's cost of monitor/enforce** | *expect K lower* | *expect K higher* |
| Neighbouring a park ranger office | 0.69** | 0.27 |
| Mean % hilly area (>20°) | 9.92* | 11.34 |
| Mean elevation (m above sea level) | 1,186 | 1,135 |
| ***b* = community's benefits from use** | *expect b lower* | *expect b higher* |
| Food shortages, 1980-2001 (1 = yes) | 0.64** | 0.91 |
| Max % loss of harvest due to drought, 1980-2001 | 51.67 | 63.18 |
| % village temporary outmigrants, 2001 | 2.46** | 0.35 |
| % of community area located inside park | 62.87 | 47.67 |
| % principle livelihood from timber 2001 | 0.56 | 0.89 |
| % principle livelihood rattan and timber | 5.77 | 2.39 |
| Price rice, Rp per kg, 2001 | 2,152** | 2,482 |
| Price coffee, Rp per kg, 2001 | 4,324** | 5,510 |
| Price rice land (rice), Rp per ha, 2001 | 9,226,600 | 9,500,000 |
| Price land (other ag), Rp per ha, 2001 | 12,240,800 | 9,931,800 |
| Rattan price, per kg, 2001 | 625 | 707 |
| Timber price, per m3, 2001 | 516,053*** | 668,182 |
| ***e* (community's extraction costs)** | *expect e higher* | *expect e lower* |
| % households with '01 off-farm earners | 6.82 | 6.43 |
| % of children 13-18 in school, 2001 | 40.12 | 31.31 |
| **$r^C$ (community's discount rate)** | *expect r higher* | *expect r lower* |
| Government/NGO credit programme, 1980-2001 (1 = yes) | 0.93** (see note below) | 0.64 (see note below) |
| Other credit programme, 1980-2001 | 0.46 | 0.27 |

Note: Receiving such credit is highly correlated with being close to the Park HQ (i.e., monitor-able). Significant differences between means of variables listed in the first column ('FF&KKM)') and the second ('PT') are indicated in the first column: *** = 0.01; ** = 0.05; * = 0.1

**<u>TABLE 4:</u> Comparing Means Set B -- FF versus KKM**

(using independent samples t-tests to indicate significance)

(yellow highlighting for consistency with hypotheses)

| | FF (11) | KKM (28) |
|---|---|---|
| ***v(L)* = conservation benefits of park** | *expect v higher* | *expect v lower* |
| Neighbouring a prime bird watching area | 0.45 | 0.42 |
| ***K* = park's cost of monitor/enforce** | *expect K lower* | *expect K higher* |
| Neighbouring a park ranger office | 0.73 | 0.67 |
| Mean % hilly area (>20°) | 12.56*** | 8.94 |
| Mean elevation (m above sea level) | 998** | 1,256 |
| ***b* = community's benefits from use** | *expect b lower* | *expect b higher* |
| Food shortages, 1980-2001 (1 = yes) | 0.55 | 0.68 |
| Max % loss of harvest due to drought, 1980-2001 | 56.36 | 49.82 |
| % village temporary outmigrants, 2001 | 0.877* | 3.08 |
| % of community area located inside park | 46.89** | 69.15 |
| % principle livelihood from timber 2001 | 1.68* | 0.13 |
| % principle livelihood rattan and timber | 12.10* | 3.28 |
| Price rice, Rp per kg, 2001 | 2,186 | 2,139 |
| Price coffee, Rp per kg, 2001 | 5,000 | 4,174 |
| Price rice land (rice), Rp per ha, 2001 | 12,028,000 | 8,423,900 |
| Price land (other ag), Rp per ha, 2001 | 20,350,000** | 9,366,600 |
| Rattan price, per kg, 2001 | 616 | 630 |
| Timber price, per m3, 2001 | 519,815 | 514,815 |
| ***s* (community's cost of setting up internal monitoring system)** | *expect s higher* | *expect s lower* |
| # hh, 2001 | 365.09 | 252.00 |
| % hh natives, 2001 | 71.99* | 85.89 |
| Evidence of conflict among native hh in community, 1995-2001 (1 = yes) | 0.91* | 0.64 |
| Evidence of conflict between native & migrant hh in community, 1995-2001 (1 = yes) | 0.45* | 0.18 |
| Evidence of conflict with hh from another village, 1995-2001 (1 = yes) | 0.36 | 0.29 |
| %HH sold all land, 1995-2001 | 2.78** | 0.55 |
| %HH with no land, 2001 | 10.91* | 3.57 |
| Land distribution, 2001 (Gini) | 0.406 | 0.385 |
| Village previously part of another village (1 = yes) | 0.36 | 0.18 |
| %working population in labour sharing | 21.31 | 22.98 |

| | | |
|---|---|---|
| groups | | |

Note: Significant differences between means of variables listed in the first column (‘FF&KKM)’) and the second (‘PT’) are indicated in the first column: *** = 0.01; ** = 0.05; * = 0.1

**<u>TABLE 5:</u> Comparing Means Set C -- KKMs with and without Transfers**

(using independent samples t-tests to indicate significance)

(yellow highlighting for consistency with hypotheses)

| | | | | |
|---|---|---|---|---|
| | KKM (promised) | | KKM (delivered) | |
| | AgDev ($\pi^C$) (13 villages) | No AgDev (15) | AgDev ($\pi^C$) (11) | No AgDev (17) |
| ***v(L)* = conservation benefits of park** | *expect $v(\bar{L})$ lower* | *expect $v(\bar{L})$ higher* | *expect $v(\bar{L})$ lower* | *expect $v(\bar{L})$ higher* |
| Neighbouring prime bird watching area (1 = yes) | 0.54 | 0.33 | 0.27 | 0.53 |
| ***K* = park’s cost of monitor/enforce** | *expect K higher* | *expect K lower* | *expect K higher* | *Expect K lower* |
| Mean % hilly area (<20°) | 9.05 | 8.85 | 8.00 | 9.48 |
| Mean elevation (m above sea level) | 1,244 | 1,266 | 1,333 | 1,211 |
| Neighbouring Park ranger office (1 = yes) | 0.77 | 0.60 | 0.55 | 0.76 |
| ***b* (community’s benefits from reducing forest level)** | *expect b lower* | *expect b higher* | *expect b lower* | *expect b higher* |
| % of community’s total area located inside park | 61.92* | 75.40 | 64.59 | 72.09 |
| % HH with principle livelihoods dependent on timber, 2001 | 0.09 | 0.15 | 0* | 0.20 |
| % HH with principle livelihoods dependent on rattan & timber, 2001 | 6.23* | 0.73 | 4.59 | 2.44 |
| % village population as temporary outmigrants, 2001 | 4.13 | 2.17 | 3.08 | 3.07 |
| Price rice, Rp per kg, 2001 | 2,218 | 2,070 | 2,289* | 2,042 |
| Price coffee, Rp per kg, 2001 | 4,146 | 4,197 | 4,300 | 4,088 |
| Price rice land (rice), Rp per ha, 2001 | 8,613,600 | 7,687,500 | 7,722,200 | 8,392,900 |
| Price land (other ag), Rp per ha, 2001 | 8,830,800 | 9,664,600 | 8,835,000 | 9,495,000 |
| Rattan price, per kg, 2001 | 570 | 714 | 588 | 667 |
| Timber price, per m3, 2001 | 530,769 | 500,000 | 463,636 | 550,000 |
| ***s* (community’s costs of internal monitoring & sanctioning)** | *expect s higher* | *expect s lower* | *expect s higher* | *expect s lower* |
| # hh, 2001 | 242.46 | 260.27 | 218.91 | 273.41 |
| % hh natives, 2001 | 82.61 | 88.75 | 91.77 | 82.09 |
| Evidence of conflict among native hh, 1995-2001 (1 = yes) | 0.55 | 0.71 | 0.54 | 0.73 |
| Evidence of conflict between native & migrant hh, 1995-2001 (1 = yes) | 0.00** | 0.29 | 0.23 | 0.13 |

| | | | | |
|---|---|---|---|---|
| Evidence of conflict with hh from another village, 1995-2001 (1 = yes) | 0.45 | 0.18 | 0.46* | 0.13 |
| %HH sold all land, 2001 | 22.57 | 4.73 | 4.46 | 18.54 |
| %HH with no land, 2001 | 5.58 | 1.84 | 2.77 | 4.09 |
| Land distribution, 2001 (Gini) | 0.45* | 0.22 | 0.34 | 0.41 |
| Village previously part of another village | 0.31* | 0.067 | 0.18 | 0.18 |
| %working population in labour sharing groups | 24.08 | 22.02 | 29.89 | 18.51 |
| **$\tau$ (community bargaining power)** | *expect $\tau$ higher* | *expect $\tau$ lower* | *expect $\tau$ higher* | *expect $\tau$ lower* |
| Evidence of conflict over forest conversion in park, between village & park | 0.38 | 0.60 | 0.55 | 0.47 |
| Knowledge of other communities moving out of the park, (1 = yes) | 0.54 | 0.33 | 0.82*** | 0.18 |
| Type of knowledge from KKMs: allow villages to use forest/forest products (1 = yes) | 0.54 | 0.60 | 0.64 | 0.53 |
| Type of knowledge from KKMs: give forest rights to communities (1 = yes) | 0.62 | 0.73 | 0.73 | 0.65 |
| Community knowledge of KKMs before or during KKM (1 = yes) | 0.75 | 0.73 | 0.70 | 0.76 |
| Why KKM? NGO worried about forest degradation, (1 = yes) | 0.54** | 0.13 | 0.45 | 0.24 |
| Why KKM? Village wanted to claim forest, (1 = yes) | 0.23* | 0.53 | 0.36 | 0.41 |

Note: Some villages that were promised claim to not have received benefits as of 2006. Yet, some villages that did claim benefits in 2006 were not promised these when the KKM was negotiated. Significant differences between means of variables listed in the first column (‘FF&KKM)’) and the second (‘PT’) are indicated in the first column: *** = 0.01; ** = 0.05; * = 0.1

## APPENDIX – RATIONALE UNDERLYING PROXIES

| Variable | High value of proxy = higher (+) or lower (-) parameter | Rationale |
|---|---|---|
| ***b* (community's benefits from reducing forest level)** | | |
| % of community's total area located inside park | + | The more territory inside park, the more community benefits from park forest exploitation. (bigger b) |
| Land per capita, ha, 2001 | ? | ? |
| % HH with principle livelihoods dependent on rattan & timber, 2001 | + | Greater proportion of HH engaged in timber and/or rattan, the more benefits to community from forest exploitation (direct use only). (bigger b) |
| % HH with principle livelihoods dependent on timber, 2001 | + | |
| % HH collecting rattan, 2001 (any rattan; not necessarily livelihood dependent) | + | |
| % village population as temporary outmigrants, 2001 | - | The more outmigrants, e.g. working in city, the less dependence on forest for livelihoods. (smaller b) |
| Erosion in village, 2001 (1 = yes) | - | Presence of erosion/more land on steep slopes/more HH investing to prevent erosion might suggest fewer benefits from further reducing forest (smaller b) |
| Cultivated land on steep slopes, 2001 (1 = yes) | - | |
| % hh construct terraces or barriers to prevent erosion, 2001 | - | |
| Villagers harvest rattan species *Batang* (1=yes) | + | The more valuable the species (increasing scarcity value) the higher the benefits of harvesting forest to the community. Batang is the most valuable species (50% higher prices per kg compared to all other species, see Komorudin et al., 2006) (larger b) |
| Price rice, Rp per kg, 2001 | + | Higher prices imply greater incentives to further exploit forest. (bigger b) |
| Price corn, Rp per kg, 2001 | + | |
| Price cocoa, Rp per kg, 2001 | + | |
| Price coffee, Rp per kg, 2001 | + | |
| Rattan price Rp per kg, 2001 | + | |
| Price rice land (rice), Rp per ha, 2001 | + | Higher land prices imply greater incentives to capitalize on more forest reduction (bigger b) |
| Price land (other ag), Rp per ha, 2001 | + | |
| ***s* (community's costs of establishing an internal monitoring & sanctioning system)** | | |
| # hh, 2001 | + | Collective action theory: more HH/people increases costs of effective collective action necessary for establishing effective monitoring and enforcement system (bigger s) |
| Population, 2001 | + | |
| % hh natives, 2001 | - | Collective action theory: greater ethnic homogeneity decreases costs of effective collective action (smaller s) |
| # ethnic groups, 2001 | + | Collective action theory: greater ethnic diversity proxied by number of ethnic groups implies increased costs of effective collective action (bigger s) |
| Per capita social organizations, 2001 | - | Collective action theory: The more social organizations per capita the more effective collective action (becomes less costly) (smaller s) |
| Majority hh assist in building houses, 2001 (1 | - | Collective action theory: The more likely |

| | | |
|---|---|---|
| = yes) | | A majority of HH collectively develop infrastructure, the more likely effective collective action (smaller s) |
| Majority hh assist in building roads, 2001 (1 = yes) | - | |
| % HH principle livelihoods outside ag and forest (off-farm, incl. wage, traders, self-employed) | + | Opportunity costs: More off-farm labour, increases opp costs of time and hence, higher costs of collective action (bigger s) |
| Km to nearest market, 2001 | + | Opportunity costs: the closer the community is to market, higher opportunity costs of time and the higher costs of collective action (bigger s) |
| Evidence of conflict among native hh, 1995-2001 (1 = yes) | + | Collective action theory: Previous conflict makes effective collective action more difficult and more costly (bigger s) |
| Evidence of conflict between native & migrant hh, 1995-2001 (1 = yes) | + | Collective action theory: Previous conflict makes effective collective action more difficult and more costly (bigger s) |
| Evidence of conflict with hh from another village, 1995-2001 (1 = yes) | + | Collective action theory: Previous conflict makes effective collective action more difficult and more costly (bigger s) |
| Land distribution, 2001 (Gini) | + | Collective action theory: greater land inequality and HH without land makes effective collective action more difficult and more costly (bigger s) |
| %HH with no land, 2001 | + | |
| Village previously part of another village | +/- | Evidence for split from another village could either make collective action easier to undertake (smaller s) or harder (bigger s) |
| %working population in labour sharing groups | - | Collective action theory: the more workers engaged in labour sharing, the easier to enable effective collective action (smaller s) |
| ***$r^C$* (community's discount rate)** | | |
| % hh owning tvs, 2001 | - | Higher proportions of ownership of material goods indicates less poverty in community and hence, lower discount rates (smaller r) |
| # cars/trucks per capita, 2001 | - | |
| # motorbikes per capita, 2001 | - | |
| % children 13-18 in schools, 2001 | - | More children (teens) in school indicate that parents would prefer them to learn in order to increase future potential earnings instead of working in fields (smaller r) |
| % hh with electricity, 2001 | - | Better infrastructure indicates less poverty (smaller r) |
| % hh with permanent houses (stone/cement), 2001 | - | |
| % hh with pumped water to house, 2001 | - | |
| Per capita # shops & kiosks, 2001 | + | More shops per cap indicate preference for current consumption over future consumption (higher r) |
| Government/NGO credit programme, 1980-2001 (1 = yes) | - | Evidence of credit indicates collateral and possibilities for investment for future returns (smaller r) |
| Other credit programme, 1980-2001 (1 = yes) | - | |
| Per capita # ploughs, 2001 | - | Higher proportions of ownership of ag capital indicates less poverty in community and hence, lower discount rates (smaller r) |
| Per capita # hand tractors, 2001 | - | |
| Per capita # chainsaws, 2001 | - | |
| Per capita # rice mills, 2001 | - | |
| Food shortages, 1980-2001 (1 = yes) | + | Evidence for drought/food subsidies/food shortages indicates more poverty (bigger r) |
| % hh receiving food subsidies, 2001 | + | |
| Max % loss of harvest due to drought, 1980-2001 | + | |
| % hh with land certificates for homestead, 2001 | - | Higher proportions of land certificates indicate stronger tenure and less potential for poverty (lower r) |
| % hh with land certificates for ag land, 2001 | - | |
| ***K* (cost to Park for monitoring and enforcement)** | | |

| | | |
|---|---|---|
| Community accessible by car (asphalt, concrete road), 2001 ((1 = yes) | - | Better accessibility to community and surrounds makes it easier (cheaper) for park to monitor (smaller K) |
| Mean distance to road, 2001, km | + | The further community territory from road, the more expensive for park to monitor (bigger K) [could also affect V and b] |
| Distance to park HQ in Palu, km | + | Note data currently not available. The further away from Park HQ, the more costly to monitor (bigger K) |
| Average slope (°) | + | The bigger the slope, the harder and more difficult for Park to monitor (bigger K) [could also affect b and s] |
| Mean elevation | + | The higher the elevation, the more difficult for Park to monitor (bigger K) [could also affect b and s] |
| Side of park (south=1; north=0) | + | The more on the south side of the park, the more difficult and expensive for Park to monitor as further from Palu (Park HQ) along with worse roads and infrastructure compared to those on the north side and closer to Palu (bigger K) [in case of no further data this could be second-best proxy] |
| **τ, community bargaining power** | | |
| Years since park borders established on village land, 2006 | - | The longer park borders established the harder for community to claim (smaller **τ)** |
| Yrs since village situated in current location, 2006 | + | The longer the community resident in current location the stronger its claim over resources (bigger **τ)** |
| Knowledge of other communities moving out of the park, 2006 (1 = yes) | + | Knowledge of other communities implies community can learn about strategy (bigger **τ**) |
| Community knowledge of KKMs (all) (1 = yes) | + | The more the community knows about other KKM and the costs and benefits of an agreement, the stronger its bargaining power? (bigger **τ**) |
| Type of knowledge from KKMs: allow villages to use forest/forest products, (1 = yes) | + | |
| Type of knowledge from KKMs: give forest rights to communities, (1 = yes) | + | |
| Type of knowledge from KKMs: prevent forest degradation, (1 = yes) | + | |
| Community knowledge of KKMs before or during KKM (1 = yes) | + | The more the community learns about other KKM before it negotiates its own KKM, the more bargaining power it has (bigger **τ**) |
| Why KKM? NGO worried about forest degradation, (1 = yes) | + | The more the other party is worried about forest deg and the more it has preferences to claim forest, the more power the community has, (bigger **τ**) |
| Why KKM? Village wanted to claim forest, (1 = yes) | + | |
| NGO worked in village previous to KKM, (1 = yes) | - | The more an NGO is entrenched in a village the less power the community has (smaller **τ**) |
| KKM negotiated with Park present (1 = yes) | ? | If other actors are present during negotiations, it could either strengthen or weaken the community's position. |
| KKM negotiated with local gov present (1 = yes) | ? | |
| **e, (community's expected cost of being caught)** | | |
| Evidence of conflict over forest conversion in park, between village & park | + | Evidence of reputation for breaking forest rules may increase probability of being monitored and caught by Park (bigger e) |
| **V, benefits from conservation** | | |
| #endemic bird spp, 2001 | + | Endemic bird spp are a big draw for LLNP and important factor for TNC's long involvement in the area. |