Community–Industry Contracting over Natural Resource Use in a Context of Weak Property Rights: The Case of Indonesia

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Accepted 20 July 2005

Abstract. Decentralization in Indonesia has resulted in an increased influence of local communities over the terms of logging agreements with timber companies. The outcomes of such community–company negotiations vary significantly across communities. What are the conditions that cause this variation, and how can the outcomes be more effectively and efficiently influenced by third-party actors such as the local government or NGOs? This paper addresses these questions by developing a game-theoretic model to illustrate the strategic interactions between communities and companies. The model allows for endogeneity of de facto property rights and bargaining positions. We show that third-party actions to improve the community’s bargaining position by raising its reservation utility may result in an increase in the area logged and thereby harm the environment. Our results indicate that the strategy of intervention matters. In particular, strategies that raise the sensitivity of interventions to local logging threats are likely to be more cost-effective in supporting communities and reducing forest degradation than more indiscriminatory strategies. The model will be relevant to other situations where communities negotiate contracts over natural resource use with outside actors in a context of weak property rights, a situation increasingly observed in other developing countries.

Key words: bargaining, community–industry negotiations, decentralization, endogenous property rights, logging contracts, natural resources

JEL classifications: 012, 013, Q15, Q23, C72

This research forms part of the research group “Determinants and effects of alternative institutions for natural resource management in developing countries”, funded by the Robert–Bosch Foundation. The empirical research in Indonesia is conducted in cooperation with the Center for International Forestry Research (CIFOR) in Bogor. An earlier version of this paper was presented at the Annual Meetings of the International Society of New Institutional Economics in Budapest, September 11–13, 2003.
1. Introduction

Decentralization and related institutional reforms in Indonesia have resulted in an increased influence of local communities over the terms of logging agreements with timber companies. Communities are now actively engaged in negotiating with companies over logging on land to which they have uncertain property rights. The outcomes of such negotiations vary significantly across communities. In some cases communities are able to enforce their informal rights and, hence, effectively bargain with firms, while other communities appear to get exploited by firms. Even where communities have been successful in enforcing their rights sufficiently to force firms to negotiate actually, the financial and environmental contract provisions have significantly varied.

What are the conditions that cause this variation, and how can the outcomes be more effectively and efficiently influenced by third parties such as NGOs and donor agencies? This paper addresses these questions by developing a game-theoretic model to illustrate the strategic interactions between communities and companies. The model is validated using empirical evidences from East Kalimantan.

We contribute to the existing literature in several ways. The earlier literature on the effect of decentralization and devolution on natural resource management focuses largely on the determinants of successful collective action by local communities to achieve efficient management outcomes (e.g., Baland and Platteau 1997a, b, 1998; Ostrom 1990; Bardhan 1993a, b). It generally takes property rights as given and ignores potential interactions with outside actors. Another strand of the literature models conflicts over property rights (Alston et al. 1999; Angelson 2001; Burton 2004), but does not link potential conflict to the alternative of negotiation. In this paper, we model the interaction of local communities with logging companies in a context of uncertain property rights. We endogenously model property right enforcement and explicitly link it to the feasibility and results of community–firm bargaining. Moreover, we model the effects of outside intervention by third parties such as NGOs to improve communities’ bargaining positions in a situation where at least some of the environmental impacts are not represented by any of the parties in the bargaining process.

Specifically, we developed a game-theoretic model consisting of three stages. In the first stage, the firm chooses the area it proposes to log. In the second stage, community–company bargaining over a mutually agreed contract takes place. The model allows for endogenous bargaining positions. Reservation utilities depend on the outcome of a third-stage game where each party may attempt to attain de facto property rights. An implication of the third-stage game is that community reservation utility in stage two (bargaining stage) is likely to be affected by the amount of logging.
We show that third party interventions to improve the community’s bargaining position may result in an increase in the area logged and thereby harm the environment! Our results indicate that the strategy of intervention is significant. In particular, strategies that raise the sensitivity of interventions to local logging threats are more likely to be effective in supporting communities and reducing forest degradation – and achieve both objectives at a lower cost – than more non-discriminatory strategies.

While the model presented in this paper is motivated by the Indonesian context, it is likely to be relevant to any situation where communities negotiate contracts over natural resource use with outside actors (like companies) in a context of weak property rights to the resource. This is a situation frequently found in developing countries (Feder and Feeney 1991; Alston et al. 1999). For example, in countries like Indonesia, India, South Africa, Papua New Guinea, Ghana, and Mexico, companies expecting to exploit forest products now frequently need to negotiate with local communities that have some rights over forest resources (Mayers and Vermeulen 2002; Bray et al. 2003). The general trend towards decentralization and participatory approaches in many other countries may naturally lead to similar types of developments.2

The paper is structured as follows. Section 2 describes the institutional setting in Indonesia and provides necessary facts relevant to our analysis. Section 3 presents the model. Section 4 examines the effect of alternative strategies of intervention by third-party actors on the environment. Section 5 concludes.

2. The Institutional Setting

Ten percent of the world’s tropical forests are located in Indonesia, covering 40 percent of the country’s land area and representing the second largest forest coverage in the world. Over the past five decades, forest cover has declined dramatically, from 162 to 98 million hectares (FWI/GFW, 2002), mainly due to the rapid expansion of commercial logging.

After the fall of the highly centralized system of governance that characterized ex-President Suharto’s New Order regime in 1998, Indonesia has undergone a process of rapid and far-reaching decentralization (Barr and Resosudarmo 2002). Consequently, considerable degrees of administrative and regulatory responsibility across broad segments of the economy have been transferred from the national government in Jakarta to the country’s provincial and district governments. The transfer involved sector-specific decentralization laws, in particular a revised version of Indonesia’s Basic Forestry Law. This legislation aimed at allowing communities residing in or near forest areas to engage in forest management activities, mainly by acknowledging customary rights to land and forest areas.
These customary rights are, however, yet to be clearly defined, particularly in relation to logging concessions policy (Wollenberg and Kartodihardjo 2001). In addition to this fact, the endemic corruption of the Indonesian forest sector means that these “rights” are usually not formally enforced by the government (Richards et al. 2003). The revised forestry law gave district heads the right to hand out small-scale forest conversion licences known as Timber Extraction and Utilization Permits (Izin Pemungutan dan Pemanfaatan Kayu or IPPK). Since 1999/2000, hundreds of IPPK permits have been issued in East Kalimantan, with concessions cumulatively covering hundreds of thousands of hectares of forest land (Barr et al. 2001; Palmer and Obidzinski 2002; Obidzinski 2003).

A province-level law was enacted in East Kalimantan in 2000, which required firms to pay compensation to communities for the harvesting of timber (Wollenberg, pers. comm.) and to secure a harvesting agreement with the communities living in or around the harvesting area prior to harvesting. Communities negotiate for the payment of fees, material benefits, and infrastructural developments in exchange for giving the company the “right” to timber production. Barr et al. (2001) note that the availability of IPPK permits has dramatically increased competition regarding resource claims, which are being made in an atmosphere of “confusion and fierce competition amidst a general lack of information about the legal basis for village boundaries or rights to forest resources” (p. 27). Consequently, property rights are still weakly defined in a legal sense and can be claimed by companies and communities. In the case of the company this usually takes the form of making promises that are not complied with later (Barr et al. 2001; Palmer 2004a).

Anau et al. (2002), Barr et al. (2001), and Palmer and Obidzinski (2002) indicated mixed outcomes from these negotiations, both in terms of payments negotiated (including the provision of material benefits and public goods) and environmental impacts. Barr et al. (2001) observed that, increasingly, these contracts have included “absurd agreements or have been unfulfilled.” Consequently, community protests against IPPK operations since mid-2001 have increased when firms attempted to continue to log even when negotiations failed. These protests typically take the form of extended community blockades in which logging roads are blocked, company property such as machines are stolen and logging camps are set on fire. Alternatively, the firm may withdraw from the proposed concession.

The logging firm usually has a first-mover advantage in approaching a community with a take-it-or-leave-it offer regarding the size of the proposed logging area. Thus, logging area is typically not negotiated although communities may have some say in the location (Palmer 2004a). While local government does not tend to get involved in the original negotiations, it acts when conflicts arise and when renegotiation of logging agreements takes
place (Obidzinski 2003). Renegotiations are largely focused on compensation payments (Palmer 2004a).

In addition, it is clear from the outcomes of these agreements that the environmental damage from the logging activities is not being fully internalized neither by the communities nor by firms, particularly with regards to the global values associated with the forests such as biodiversity and carbon storage (Palmer 2004a). Consequently, NGOs have been attempting to intervene by providing information to communities in relation to the value of the standing forest, and by assisting in leveraging the communities’ negotiation strategies (e.g., CIFOR 2002).

From our discussion, we summarize the following essential facts which are relevant to our modeling effort:

- Property rights are still weakly defined in a legal sense and can de facto be claimed by companies (through harvesting attempts) and communities (through blockades).
- The logging firm has first-mover advantage in approaching the community with a take-it-or-leave-it offer regarding the size of the proposed logging area.
- The compensation payment to the community is also usually first proposed by the firm, but is frequently renegotiated in a new round of community–company negotiations, with local government acting as a mediator.
- At least some of the environmental impacts are not represented by any of the parties in the bargaining process (due to externalities, information imperfections, and tenure insecurity).

3. A Model of Community–Company Contracting with Endogenous Bargaining Positions

In this section, we develop a game-theoretic model consisting of three stages. In the first stage, the firm chooses the area it proposes to log. In the second stage, community–company bargaining over a mutually agreed contract takes place. As we will see in the following section, the negotiation outcomes depend crucially on the company’s and community’s bargaining positions. A major determinant of bargaining position are the players’ reservation utilities. However, in a context of weak property rights reservation utilities are not fixed, but rather are the outcome of a third-stage game that we model in the following section.

3.1. THE THIRD STAGE: PROPERTY RIGHTS FORMATION

Our analysis of the third stage adapts ideas from conflict theory and uses them to determine the feasibility of bargaining as well as key parameters
affecting it. Conflict theory (see, e.g., Dixit and Nalebuff 1991) usually assumes the existence of two actors. In our case one of the actors has the ability to exploit a resource while the other one may under some circumstances prevent such exploitation. We assume that logging requires a specific factor (e.g., capital) that is available to the firm, but not to the community. This can be justified by the assumption that communities are poor (have low savings) and have a disadvantage in the credit market vis-à-vis the firm, associated with capital market imperfections (see, e.g., Bose 1998).

The possibility of bargaining arises from the complementarity between the firm and the community in terms of access to the factors of production required for logging. The firm has access to capital, while the community may be able to control the natural resource. There are two possible outputs here: timber, the extraction of which requires both capital and the natural resource, and non-timber products provided by the standing forest (e.g., water retention services, flood prevention, firewood, wildlife), which does not require the use of capital. When the incentives are such that the benefits from the standing forest dominate those of timber products under all feasible distributions, then the community does not bargain and thus the standing forest is protected. Otherwise, and if the community is able to exert property rights, bargaining would be the outcome. This issue will be addressed in more detail below.

In the perfect information case, one of the actors can in principle impose its conditions (e.g., the firm may unilaterally exploit the resource if it has enough power to win a war of attrition, or the community may prevent that if the power conditions are reversed). We argue that the outcome of this process is asymmetric: If the firm is able to win a war of attrition, the community will effectively lose property rights for the resource and hence, the firm will exploit it unilaterally as an open access resource. If, however, the community is able to win a potential conflict, then it effectively is able to exert property rights upon the resource. That is, the community has formal legal rights – however vaguely defined this might be by the law – as well as the ability of effective enforcement. In this case, bargaining between the community and the firm may take place.

To model the potential conflict over property rights, we follow the setup presented by Burton (2004) in a simple discrete-time, perfect-information model. Let \( p(L,K) \) denote the total net benefits from logging, where \( L \) is the area logged and \( K \) is a specific factor of production available to the firm, but not to the community. We assume that \( p \) is increasing and concave in \( L, p(L,0) = 0, \) and \( p(0,K) = 0. \) In what follows we suppress the argument \( K \) as it is not subject of the game considered. Let \( \bar{v} \) denote the maximized profit of the firm from logging unilaterally (i.e., \( \bar{v} = v(\bar{L}) \), where \( v'(\bar{L}) = 0 \). Also let \( c \) be the fixed cost of a unilateral logging attempt by the firm in a given period (with \( c < v \)), \( \rho \) be the firm’s discount factor, \( \phi \) be the community’s discount factor, \( s \)
be the per-period cost incurred by the community in trying to prevent the firm from exploiting the resource (e.g., the cost of setting up road blockades), and $b$ are the per-period benefits of the standing forest to the community.

Both players can attempt to obtain de facto property rights over the resource: the firm by trying to log unilaterally, and the community by setting up blockades to stop the firm from logging. Each period the firm stays in conflict it incurs costs $c$, while its potential gains from fighting are given by the profits from logging unilaterally, $\hat{v}$. The community’s cost of staying in conflict in any period is $s$. While in conflict the community gains $b$ each period by preventing the firm from logging. If the community wins the conflict it also obtains $b$ in every period forever after.

First note that if $b/(1 - \varphi) < s$, the community never enters into conflict. This is because its costs of fighting for even one period ($s$) exceed the maximum benefits attainable from such a fight, namely the present value of protecting the forest forever ($b/(1 - \varphi)$). Thus, as long as the firm’s benefits from logging ($\hat{v}$) exceed the costs of a unilateral logging attempt ($c$), the firm will always win the conflict and establish de facto rights over the resource. For $b/(1 - \varphi) \geq s$, the party that could persist in a potential conflict the longest wins the attrition war. Burton (2004) derives the maximum lengths of time, $t^C$ and $t^F$, that the community and the firm can stay in conflict while still receiving a non-negative expected payoff. Setting $t^C < (>) t^F$, he shows that the firm (community) would be able to persist longer and thus win the conflict if $\hat{v} > (\leq) \left[ \frac{\ln \rho}{\ln \varphi} \right]^{\frac{1}{\kappa}} \left[ \frac{\ln \varphi}{\ln \rho} \right] - \rho$, and knowing this, the community (firm) would withdraw immediately. Thus, in summary, the following boundary condition for pure strategy outcomes is obtained (and more formally derived by Burton):

$$\hat{v} = \Omega \equiv \begin{cases} c & \text{for } b \leq s(1 - \varphi) \\ \left[ \frac{\ln \rho}{\ln \varphi} \right]^{\frac{1}{\kappa}} \left[ \frac{\ln \varphi}{\ln \rho} \right] - \rho & \text{for } b \geq s(1 - \varphi), \end{cases}$$

where $\kappa = \ln \rho / \ln \varphi$.

If $\hat{v} > \Omega$, the firm would win a potential conflict, which can be interpreted as the case where the community is not able to effectively enforce its property rights. If the firm cannot acquire permanent legal property rights, this amounts to a situation of open access. If, however, $\hat{v} < \Omega$ (e.g., if $b$ is large or $s$ is low), then the community is able to establish effective property rights on the resource. This is the final conclusion of conflict analysis in the literature. For us, however, it is the starting point.

Figure 1, adapted from Burton, shows the possible property right outcomes and the potential for bargaining arising from the conflict game. The possibility of bargaining arises only when the community is able to exert property rights ($\hat{v} < \Omega$), which corresponds to areas II and III in Figure 1.
Otherwise, there is no reason why the firm will be interested in negotiating with the community, as shown in area I ($\bar{v} > \Omega$). In reality, this may result in the firm exploiting the community through poor deals or non-compliance with agreements. For example, in Malinau district in East Kalimantan, the villages of Paking Lama and Semolon negotiated a fee of IDR 25,000 per m³, (USD 2.78). They actually received less than IDR 5,000 per m³ (USD 0.56) with no actions on the part of the respective communities (see Palmer 2005). By contrast, a joint agreement made among the people from the villages of Sebatu, Tanjung Lima and Tajan with a company resulted in a conflict after the company refused to pay the promised fee monies. This conflict was won by the communities and a new agreement made (see Palmer 2005).

If the conditions for the community to enforce property rights are met then bargaining may or may not take place. The separation between areas II and III (the line $\bar{v} = c + b/(1-\varphi) + d^F$) indicates the locus of points for which the maximum net income from logging ($\bar{v} - c$) is just equal to the sum of reservation utilities (given by $b/(1-\varphi) + d^F$). Thus, in area III in Figure 1 the value of the standing forest to the community is higher than even the most favorable bargaining outcome, and hence, there is no bargaining and no logging. By contrast, in area II, bargaining and logging are feasible.

The previous analysis suggests that the community is more likely to acquire property rights (areas II and III in Figure 1) when the following conditions prevail:

\[v = \Omega\]

**Figure 1.** Possible outcomes of the pre-bargaining property right game.
• the profitability of timber ($\tilde{v}$) is relatively low,
• logging costs ($c$) are relatively high, and/or the costs of a blockade ($s$) are low (e.g., the community is homogenous and well-organized),
• the value of the standing forest to the community ($b$) is high, e.g., because the use value of the forest to the community is high and/or the environmental services provided by the forest are high and/or the community is aware of the full value of (local) environmental services provided by the forest and/or the community internalizes some or all of the global environmental services provided by the forest (through, e.g., carbon credits or conservation payments),
• the firm’s discount rate is high ($\rho$ is low), and/or the community’s discount rate is low ($\phi$ is high).

Table I shows the parameter values likely to be associated with the three outcomes of the property rights game.

### 3.2. THE COMMUNITY RESERVATION UTILITY

If the community is able to enforce property rights and the value of the standing forest is not too high (area II in Figure 1), then – as shown above – community–company bargaining is feasible. This seems to have been the case in a large number of communities in East Kalimantan. For example, communities in the sub-district of Sekatak negotiated for and received payments of between IDR 30,000 (USD 3.33) and IDR 50,000 (USD 5.56) per m$^3$ for log production (see Palmer 2004a).

From hereon, we thus focus on the case where the community could win a potential conflict. In that case, the community’s reservation utility becomes a crucial factor in determining the outcome of potential bargaining. In this section we consider the determinants of this reservation utility. The community’s reservation utility is given by the present value of the standing forest lost through logging as considered by the community. $^9$ The standing forest

### Table I. Parameter values and outcomes of the pre-bargaining property right game

<table>
<thead>
<tr>
<th>Parameter</th>
<th>No bargaining, logging (Region I)</th>
<th>Bargaining, logging (Region II)</th>
<th>No bargaining, no logging (Region III)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profitability of timber ($\tilde{v}$)</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Fixed costs of logging ($c$)</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Blockade costs ($s$)</td>
<td>High</td>
<td>Low or medium</td>
<td>Low or medium</td>
</tr>
<tr>
<td>Value of standing forest ($b$)</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Firm discount rate</td>
<td>Low</td>
<td>Medium or high</td>
<td>Medium or high</td>
</tr>
<tr>
<td>Community discount rate</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
</tbody>
</table>
usually has further values that the community does not necessarily consider. These include the regional and global services provided by the standing forest, e.g., at the regional level – water retention, flood prevention, erosion control, etc., and – at the global level – carbon retention and biodiversity preservation. Depending on the community’s level of awareness, it may not even consider all the local environmental values of the forest to the community. Therefore, we can write the community’s valuation of the standing forest in the absence of logging as:

\[ b/(1 - \varphi) = B(\bar{L}) + p(L)X(\bar{L}), \]

where \( \bar{L} \) is the total forest area available in the community, \( B(\bar{L}) \) is the value of the standing forest perceived by the community in the absence of logging (e.g., use values from hunting or fruit collection, as well as local environmental amenities), \( X(\bar{L}) \) are the values of the standing forest not perceived by the community, and \( p(L) \) is the probability that an outside actor (e.g., an NGO or donor agency) intervenes to motivate the community to internalize \( X \), e.g., through conservation payments or awareness building on local values that the community otherwise fails to consider.

The probability of intervention (and thereby the community’s reservation utility) generally depend on the amount of logging proposed by the firm (\( L \)) for the following reason. If the firm becomes too aggressive in its logging plans, it may attract more attention from NGOs, donor agencies, and even national government, to raise environmental values and awareness. Outside sources may thus be more willing to provide technical support, education, and sometimes even conservation payments to the communities. Thus, third-party intervention improves the communities’ bargaining position.

We postulate that the probability function is affected by such intervention as follows:

\[ p(L; \gamma, \mu) = \frac{(L + \mu)^\gamma}{\bar{L} + \bar{\mu}}, \quad \gamma \in [0, 1] \]

where \( \gamma \in [0, 1] \) is a parameter reflecting the responsiveness of third-party interventions to forest scarcity (logging), \( \mu \) is a parameter reflecting interventions that are independent of local logging threat, and \( \bar{\mu} \) is the maximum level of \( \mu \). Since \( L + \mu \leq \bar{L} + \bar{\mu} \) we thus impose in fact that \( p \in [0, 1] \).

Adjusting the units of \( L \), so that \( \bar{L} \) is very large, \( \lim_{\mu \to 0} p = 0 \). Thus, \( p \) is zero when both types of intervention are zero.

We assume that the firm arrives at an ex ante estimation of \( p \) on the basis of experience. The key observation for the firm is to understand how outside entities (e.g., environmentalists) respond to deforestation. The degree of responsiveness or sensitivity of outside entities’ interventions to logging is reflected in the parameter \( \gamma \). The higher \( \gamma \) is, the greater such response.
Environmental interventions that are less discriminatory – so that a wide range of communities is targeted regardless of the specific local logging threat – are reflected in the parameter $\mu$. A higher value of $\mu$ suggests more widespread interventions by environmentalists that are not necessarily correlated to localized logging threats.

In Section 4 we will analyze the impacts of the alternative strategies of intervention (through $\mu$ or $\gamma$) on environmental outcomes.

Now, we can similarly write the value of the standing forest to the community when logging takes place as $B(L - L) + p(L)X(L - L)$. Thus, potential interventions as a reaction to deforestation will also affect this value. The community’s reservation utility (or the minimum amount that the community has to receive to participate in a contract) is given by

$$d_C = B(L) - B(L - L) + p(L)[X(L) - X(L - L)].$$

(3)

3.3. THE SECOND STAGE: COMMUNITY – COMPANY BARGAINING OVER COMPENSATION FOR LOGGING

We now proceed to analyze the second stage, i.e., the bargaining between the community and the company over a logging agreement. We model the community – firm negotiation as a Nash bargaining game.\(^{11}\) It is assumed that negotiations are costless. Denote the payoffs assigned to the community and the firm negotiated in the logging contract by $\pi_C$ and $\pi_F$, respectively ($\pi_C + \pi_F = v(L)$). Furthermore, $d_F$ denotes the reservation utility of the firm, which represents the opportunity cost of the firm in other activities, assumed here for simplicity to be constant. In general, assuming for simplicity risk neutrality, the Nash bargaining solution is found by solving the following problem (Gintis, 2000, p.348):

$$\max_{\pi_C, \pi_F} \left[ \pi_C - d_C(L) \right]^{1-\tau} \left[ \pi_F - d_F \right]^{\tau} \text{ s.t. } \pi_C + \pi_F = v(L),$$

where $\tau$ and $1-\tau$ are the community’s and firm’s relative bargaining powers, respectively. As noted by Muthoo (1999), under certain assumptions, $\tau$ is inversely (directly) related to the community’s (firm’s) discount rate. Specifically, $\tau \equiv r^F/(r^F + r^C)$, which means $0 \leq \tau \leq 1$. The first-order condition for the firm’s and community’s payoff is thus given by

$$\pi^F = d^F + (1 - \tau)(v(L) - d^C - d^F), \quad \pi^C = v(L) - \pi^F.$$  

(4)

A well-known result in the literature is that bargaining payoffs are increasing in the respective player’s reservation utility. In our model this implies that community payoffs are increasing in the community’s valuation of the standing forest and decreasing in the community discount rate.
We now proceed to the first stage of our game, the firm’s decision on what area or amount of logging to propose for the negotiation.

3.4. THE FIRST STAGE: THE FIRM’S PROPOSAL ON LOGGING EXTENT

In the first stage of the game, the firm decides the extent of logging (the timber volume or area to be logged, denoted by $L$) which it proposes to the community. To analyze the firm’s choice we need to examine how the firm’s payoffs ($p_F$) depend on the level of logging. In particular, the firm may want to consider the probability that outsiders make the implementation of any planned logging deal more expensive by having to increase $\pi^C$ due to the increase in community reservation utility ($d^C$). Therefore, the effect of logging on the community’s reservation utility may affect the firm’s choice of logging area.

The firm maximizes its share in total income by choosing $L$. That is, it maximizes its payoffs, given by (4):

$$\max_L \pi_F = d^F + (1 - \tau)(v(L) - d^C(L) - d^F).$$

subject to (3). Thus, the first-order condition for the firm’s choice of $L$ is given by

$$v_L(L) = d^C_L(L), \quad (5)$$

or, using (3),

$$v_L(L) = B'(\bar{L} - L) + p(L)X'(\bar{L} - L) + p_L(L)[\bar{X} - X(\bar{L} - L)], \quad (5')$$

where $\bar{X} \equiv X(\bar{L}), v_L \equiv \partial v(L)/\partial L, p_L \equiv \partial p(L)/\partial L, B'(\bar{L} - L) \equiv \partial B(\bar{L} - L)/\partial (\bar{L} - L)$, and $X'(\bar{L} - L) \equiv \partial X(\bar{L} - L)/\partial (\bar{L} - L)$. The left-hand side of Equation (5') shows the marginal benefits from logging, while the right-hand side shows the costs. The first and second term on the right-hand side represents the marginal decrease in environmental benefits due to higher logging. The third term reflects the fact that higher logging leads to a higher probability of intervention, which causes the environmental value expected to be considered by the community to increase. Note that the logging level chosen by the firm is independent of the bargaining powers of the parties.

4. The Effects of Alternative Strategies of Third-Party Interventions

In this section, we discuss the effect of alternative strategies of third-party interventions on deforestation. In Section 4.1, we consider the implications of the introduction of a probability of intervention from a situation where such probability was initially zero. In Section 4.2., we examine the impact of changes on the probability from an original situation in which $p$ is
already positive. We show that the origin of such change (i.e., whether $p$ changes as a consequence of adjustment in $\mu$ or $\gamma$) is important in determining its impact on deforestation.

4.1. THE EFFECT OF INTRODUCING INTERVENTION

First, we consider the effect of a small increase in the probability of intervention ($p$) when initially such probability is zero. According to (2), $p$ approaches zero when $\gamma$ and $\mu$ equal zero, i.e., there is no intervention of either type. Note also that $p_L(L; \gamma, \mu) = \gamma(L + \mu)^{\gamma-1}/(L + \hat{\mu})$. Thus, if there is no intervention, the first-order condition for logging in Equation (5) reduces to $v'(L) = B'(L - L)$.

Introducing interventions of type $\mu$, without simultaneously making interventions sensitive to logging (i.e., without increasing $\gamma$), has no effect on $p$ and $p_L$ and therefore also does not affect logging.

By contrast, if interventions of type $\gamma$ are introduced, then $p$ and $p_L$ become positive and the community’s reservation utility increases regardless of whether interventions of type $\mu$ are also introduced. In this case, the second and third term on the right-hand side of Equation (5) become positive. Thus, introducing interventions of type $\gamma$, given strict concavity of $v(L)$, leads to a lower equilibrium level of logging.

In summary, we find that the introduction of interventions that are sensitive to local deforestation reduces logging, while the introduction of indiscriminate interventions by themselves have no effect on deforestation. Note, however, that this is only true as long as the value of the standing forest remains in area II of Figure 1, i.e., bargaining takes place. If interventions of type $\mu$ are very large, so that the game shifts into area III of Figure 1, the community will no longer be interested in negotiating a logging deal and the forest will be conserved.

4.2. THE EFFECT OF INCREASING INTERVENTION

We now examine the effect of a marginal increase in $\gamma$ or $\mu$ on deforestation when both of these parameters are initially positive.

Clearly, an increase in both types of interventions raises $p$ and thereby increases the community’s reservation utility. To determine the effect on logging, we totally differentiate Equation (5), which yields

$$
\frac{dL}{d\gamma} = \frac{d_L^C}{v_{LL} - d_{LL}^C}, \quad \text{and} \quad \frac{dL}{d\mu} = \frac{d_L^C}{v_{LL} - d_{LL}^C},
$$

(6)
where double subscripts denote second derivatives. Second-order conditions require that the denominator in Equations (6) is negative. From our definitions in Equations (2) and (3) we have

\[ d_C^C(L) = B'(L - L) + p(L)X'(L - L) + p_L(L)[\bar{X} - X(L - L)], \]  

(7)

Thus, considering first a change in \( \gamma \) (and suppressing arguments for simplicity of exposition), we have

\[ d_C^L = p_L X' + p_L [\bar{X} - X] \geq 0, \]

since \( p_{\gamma}; p_{L\gamma} \) are clearly non-negative. Thus, \( d\gamma/d\gamma \leq 0 \), i.e., an increase in the sensitivity of interventions to local deforestation unambiguously leads to a reduction in logging.

For indiscriminate changes in interventions (change in \( \mu \)), the effect is more complex. We have

\[ d_C^L = p_\mu X' + p_{L\mu}[\bar{X} - X], \]  

(8)

Note that \( p_\mu(L, \gamma; \mu) = \frac{\gamma(L + \mu)^{-1}}{L + \mu} \geq 0 \), and \( p_{L\mu}(L, \gamma; \mu) = \frac{\gamma^2(L + \mu)^{-2}}{L + \mu} \leq 0 \) (since \( \gamma \leq 1 \)). Thus, the first term on the right-hand side of Equation (8) is positive, while the second term is negative. Hence, the total impact of increases in intervention of type \( \mu \) on \( L \) is ambiguous. This implies that increasing certain interventions aimed at improving the community’s bargaining position may harm the environment by leading to more logging! In particular, increasing \( \mu \) without at the same time raising the sensitivity of \( p \) to logging (i.e., \( \gamma \) constant) may increase deforestation. By contrast, increasing the responsiveness of intervention to local logging threat (\( \gamma \)) unambiguously reduces forest degradation. Thus, the strategy of intervention by NGOs or other outside actors matters.

Let us now take a closer look at the conditions for such a negative effect on the environment to occur. We find that increases in \( \mu \) lead to an increase in logging if and only if

\[ p_\mu X' + p_{L\mu}[\bar{X} - X] \leq 0. \]  

(9)

The first effect reflects an increase in the marginal environmental cost of logging due to the increase in the probability of intervention. The second term represents the decrease in the marginal environmental cost of logging as evaluated by the community due to the fact that an increase in indiscriminate interventions (\( \mu \)) reduce the sensitivity of intervention to logging (\( p_L \)). Note that, given our definition of \( p \), we have \( p_\mu = p_L \) and \( p_{\mu L} = p_{LL} \). We can thus rewrite condition (9) as
\[
\frac{p_L X}{L - L} \left\{ X' \frac{\hat{L} - L}{X} + p_{LL} \frac{\hat{X} - X \hat{L} - L}{X} \right\} \leq 0,
\]

or, equivalently,

\[
X' \frac{\hat{L} - L}{X} \leq \left| p_{LL} \frac{L}{p_L} \right| \frac{\hat{X} - X \hat{L} - L}{X}.
\]

The left-hand side of Equation (9') represents the elasticity of \( X \) (the environmental values not perceived by the community in the absence of intervention) with respect to the level of standing forest, while the term \( |p_{LL}(L/p_L)| \) is the elasticity of \( p_L \) (the responsiveness of intervention to logging) with respect to logging. The latter term can also be interpreted as the curvature coefficient of \( p \) with respect to \( L \). Thus, the more concave is \( p \) in \( L \) and the less elastic is environmental value to forest level, the more likely it is that an increase in indiscriminate interventions (\( \mu \)) leads to an increase in forest degradation.

Another way to analyze condition (9') is the following. Let us normalize for simplicity \( \hat{L} \equiv 1 \) (so that \( L \) reflects the proportion of forest logged), and assume that \( X \equiv (1 - L)^{1-\eta} \), with \( 0 < \eta < 1 \). Using our expressions for \( p_{\mu} \) and \( p_{L,\mu} \), and reorganizing, we can then rewrite condition (9') as

\[
\eta + \left| p_{LL} \frac{L}{p_L} \right| \frac{1 - X}{X} \frac{1 - L}{L} \geq 1.
\]

Note that \( \eta \) is the curvature coefficient of \( X \) (i.e., \( \eta = \left| \frac{X'}{X} [1 - L] \right| \)). So the outcome of an increase in \( \mu \) on logging depends on the curvature of \( X \) and \( p \). If the weighted sum of the curvature coefficients of \( X \) and \( p \) is greater than one, then logging increases when \( \mu \) increases. Thus, increasing type-\( \mu \) interventions is likely to lead to more logging when both \( X \) and \( p \) are very concave.

Again it should be noticed that our discussion has focused on the case where bargaining takes place (region II of Figure 1). An increase in \( \mu \) (and also in \( \gamma \)) – if massive enough – could change parameters of the game enough to shift the outcome to area III in Figure 1, which means no bargaining and no logging, with obvious environmental benefits. Notice, however, the difference between the two approaches. Within the bargaining process, what matters is that firms know that outside actors would intervene, i.e., actual financial outlays are not necessary once the credibility of the outside actors is established. By contrast, switching the game into “pure conservation” implies an actual financial cost to outside actors in all cases (not only during the process of establishing credibility) that could be quite large.
5. Conclusions

Guided by the incidence of community–company logging contracts in Indonesia, we have developed a model of community contracting with outside actors over natural resource use in a context of weak definition or enforcement of property rights to the resource. The model provides a potential explanation of why we observe different negotiation outcomes with respect to logging activities that seem to arise out of community–firm consent (bargaining) and more anarchical logging with firms seemingly not complying with community demands. Also it explains why in certain cases communities are willing and able to successfully prevent logging altogether.

The model helps us to provide hypotheses on the types of parameters and combinations of parameters that lead to some specific outcomes. In particular, we find that the community is likely to share the benefits of logging in situations where the value of timber is low, logging costs are high, the value of the standing forest to the community is high, the costs of a blockade are low (e.g., in homogeneous, well-organized communities), the firm’s discount rate is high, and/or the community’s discount rate is low. In such situations the community is more likely to exert _de facto_ property rights over the forest resource and therefore can become a bargaining party that the firm has to consider. Otherwise, the firm may act unilaterally. If the value of the standing forest as perceived by the community is large, it is more likely that the community will opt to prevent any form of logging.

We have argued that the community’s bargaining power is endogenous if outside interventions in favor of communities are sensitive to logging. Assuming that firms are able to incorporate this feature into their logging choice, this endogeneity reduces logging with respect to the case where community reservation utility is exogenous. By contrast, introducing interventions that are not sensitive to local logging threats has no effect on forest degradation, unless they are large enough to cause the community to prevent logging altogether.

We have shown that once there is third-party intervention, increasing it to improve the communities’ bargaining position can have unexpected effects on the environment. Specifically, increasing support to local communities without increasing the sensitivity of intervention to logging may _increase_ forest degradation! Intuitively, when the community’s bargaining position improves, without increasing the responsiveness of the external support to increased logging, the firm has to share a larger proportion of total net benefits with the community. The firm responds by increasing the size of the pie through increased logging. Thus, a compromise is struck at the cost of the ‘unrepresented party’ in the negotiations, namely the global environment. In such situations, outside parties can, however, achieve the objectives of improving community bargaining positions and reducing forest degradation.
simultaneously by making their intervention more sensitive to local logging threats. Hence, our analysis implies that the strategy of intervention by NGOs or other outside actors matters. This paper may thus provide some guidelines for a strategy of third-party intervention to reduce forest degradation.

It should be noted that if interventions that are not geared to local forest degradation become sufficiently large, then they may cause the community to opt for conservation rather than negotiating a logging contract altogether, with obvious benefits to the environment. A strategy that emphasizes a high degree of responsiveness of intervention to forest degradation, however, may be cheaper than the one that wholly relies on preventing forest degradation altogether. Reducing forest degradation with the former strategy involves a cost mostly during the process of establishing credibility where actual outlays are necessary and later to preserve such credibility. Once firms understand that interventions are sensitive to forest degradation they are likely to exercise self-restraint (at least when the conditions for the existence of bargaining are satisfied). Relying largely on this strategy may be effective in maximizing the impact of fixed financial resources in reducing total forest degradation.

It should, however, be noticed that a strategy based on making interventions more sensitive to forest degradation could lead to forest fragmentation as logging would be restrained but geographically spread. Moreover, our model does not consider transaction costs, which might be higher in the case of interventions that are sensitive to local forest degradation threats. On the other hand, if we rely exclusively on indiscriminate forest protection, then with limited financial resources the impact on forest degradation may be small and even completely ineffective or counterproductive if the support is spread too thinly (in which case the resources would not be sufficient to push communities into conservation (area III) anywhere).

The analysis conducted here very much follows the positive-economics tradition by considering ways of increasing the efficiency of interventions, given the goal of decreasing forest degradation. We are not judging whether such changes in forest degradation are necessarily socially optimal, even though the existence of externalities may lead one to believe so. But this is not part of our analysis. Moreover, there are a number of interesting extensions to this modeling analysis that will be considered in future work. A first one is to allow for some probability of government enforcement of property rights. A second extension is to explicitly consider intra-community decision-making and the role of rent-seeking, both by well-placed government officials and individuals living in the community. Finally, one could consider the role of moral hazard in the timing of payments by the firm and a more explicit modeling of costly monitoring activities by the community.
Notes

1. For a review of this literature see Baland and Platteau (1996) and Agrawal (2001).
2. This trend, promoted by NGOs and particularly international organizations such as the World Bank, which has taken a leading role, is currently at various stages of development in countries such as, for example, China, Brazil, Zimbabwe, and Cameroon (Ribot, 2002; World Development Reports 2000/2001 and 2003).
3. This reportedly has ranged between US$0.30 to 7.00 $/m³ in Malinau and Berau.
4. The idea that the area logged is chosen by the firm rather than part of the negotiation process is also motivated by the empirical observation that it appears to be too costly for the community to monitor the area logged. Endogenizing monitoring decisions would be an interesting extension of the model presented here.
5. For specific examples of conflict models see Burton (2004), Alston et al. (1999), and Angelsen (2001).
6. Consistent with empirical evidence, de facto rights of firms in communal lands are rarely legally sanctioned.
7. In the model with perfect information conflicts are always virtual because each player is assumed to know all the relevant parameters, so that the one that would lose the conflict withdraws. If there is imperfect information on the part of either or both players, then actual conflict is possible. But the final outcome of the conflict will be ruled by the same parameters considered in the perfect information case. Since we are not interested in whether or not there is conflict, for simplicity we focus on the perfect information case.
8. For example, in the district of Malinau, there is a case of a community asking for a “high fee” that the company refused to agree to pay. The community refused to negotiate any lower and the company subsequently withdrew (Limberg, pers. comm.).
9. There are actually two potential ways to think of the community’s reservation utility, which are related to the subsequent setup of the bargaining problem. First, we could write the community’s reservation utility as its payoffs when negotiations fail, i.e., the value of the untouched forest \(B(L) + p(L)X(L)\). In this case, the setup of the bargaining problem in the following section has to take into consideration that the total benefits to the community under a bargained agreement include not only the share of logging benefits negotiated, but also the value of the forest that remains unlogged under the agreement. This is the setup discussed in endnote 12 of the paper. A second, algebraically equivalent way of setting up the problem is the one chosen here. In Section 3.3, we write the community’s payoffs from bargaining simply as the payment negotiated (\(P\)). Then the reservation utility of the community is only given by its additional benefits from the standing forest if negotiations were to fail. This is the value of the completely untouched forest (which it would get if negotiations fail; \(B(L) + p(L)X(L)\)) minus the value of the forest left unlogged according to the agreement (which it would get if negotiations are successful; \(B(L - L) + p(L)X(L - L)\)). Thus the reservation utility is given by the value of the standing forest lost through logging, as specified here.
10. In East Kalimantan in a number of districts, the dramatic increase in IPPK permits since the beginning of 2000 and the subsequent exposure of forest communities to negotiations processes has led to an increase in NGO (both local and international) activity in this area. For example, in Malinau the Center for International Forestry Management (CIFOR) has been involved in assisting in mapping, boundary setting exercises and information assistance in relation to community claims for rights on land earmarked for IPPK concessions since 1998 (see Anau et al. 2001). Also, in Berau a local NGO, the Union of Dayaks in East Kalimantan (PDKT) provided assistance to help coordinate the actions of local communities in order to get a better deal with logging firms in 1999 (Obidzinski...
At the international level, conservation groups such as Conservation International (CI) and the Nature Conservancy (TNC) have both been at the forefront of raising international awareness over increased logging in Indonesia. For example, CI endorses global ‘Hotspots’, at least two of which are located in Indonesia (see [conservation.org](http://www.conservation.org) and [www.biodiversityhotspots.org](http://www.biodiversityhotspots.org)), while TNC has conducted research into orang utan populations, currently endangered by logging in East Kalimantan (see Marshall 2002). Also, there has been an increase in community awareness of the potential benefits and costs to be gained from these kinds of agreements independent of NGO activities as communities learn from others’ experiences.

11. We opt for the Nash bargaining solution rather than a non-cooperative-game representation for two reasons. First, in the Indonesian setting, the local government often takes on the role of a mediator between firms and communities. Second, it has been shown that the Nash bargaining solution also represents the solution to a non-cooperative game of alternating offers where there is some probability that rejection of an offer will lead to a breakdown of the bargaining process (Gintis 2000, Chapter 15). For a more explicit discussion of the link between the NBS and the alternating offers game see Engel and López (2004).

12. Equivalently, we could write the community reservation utility as the value of standing forest in the absence of logging ($\tilde{d}^c = b/(1 - \varphi) = B(\tilde{L}) + p(L)X(L)$) and then write the negotiation problem as $\max_{\pi^c, \pi^f} \left[ \pi^c + B(\tilde{L} - L) + p(L)X(L - L) - \tilde{d}^c(L) \right]^{\frac{1}{s_1.s_2}}[\pi^c - \tilde{d}^c]^{\frac{1}{s_1.s_2}} + \pi^f = v(L)$. Note that our formulation assumes that environmental benefits are not negotiated over, but rather are always retained by the community. Otherwise, we could have the empirically absurd case where the community ends up paying the firm under the logging agreement.

13. Our model implicitly assumes that the community has no outside alternative. In the Indonesian context, communities do not appear to engage in negotiations with more than one company at the same time due to cultural factors. Once contact is established and negotiations opened with a community or group of communities, it is considered not “ethical” for them to negotiate directly with anyone else (Palmer and Obidzinski 2002).

References


CIFOR (2002), ‘Bibit Diskusi Memacu Proses Desentralisasi yang Bermanfaat bagi Masyarakat (The seeds of discussion spurring the process of decentralisation that have been useful for communities)’. Prepared for community workshop in Setarap, Malinau district in March 2003 by the Center for International Forestry Research (CIFOR), Bogor, Indonesia.


