Enforcement of Exogenous Environmental Regulations, Social Disapproval, and Bribery

Wisdom Akpalu, Håkan Eggert, and Godwin K. Vondolia

EfD

Environment for Development

RESOURCES

FOR THE FUTURE

Environment for Development

The **Environment for Development** (EfD) initiative is an environmental economics program focused on international research collaboration, policy advice, and academic training. It supports centers in Central America, China, Ethiopia, Kenya, South Africa, and Tanzania, in partnership with the Environmental Economics Unit at the University of Gothenburg in Sweden and Resources for the Future in Washington, DC. Financial support for the program is provided by the Swedish International Development Cooperation Agency (Sida). Read more about the program at www.efdinitiative.org or contact info@efdinitiative.org.

Central America
Environment for Development Program for Central America
Centro Agronómico Tropical de Investigacíon y Ensenanza (CATIE)
Email: centralamerica@efdinitiative.org

China
Environmental Economics Program in China (EEPC)
Peking University
Email: EEPC@pku.edu.cn

Ethiopia
Environmental Economics Policy Forum for Ethiopia (EEPFE)
Ethiopian Development Research Institute (EDRI/AAU)
Email: ethiopia@efdinitiative.org

Kenya
Environment for Development Kenya
Kenya Institute for Public Policy Research and Analysis (KIPPRA)
Nairobi University
Email: kenya@efdinitiative.org

South Africa
Environmental Policy Research Unit (EPRU)
University of Cape Town
Email: southafrica@efdinitiative.org

Tanzania
Environment for Development Tanzania
University of Dar es Salaam
Email: tanzania@efdinitiative.org

Enforcement of Exogenous Environmental Regulations, Social Disapproval, and Bribery

Wisdom Akpalu, Håkan Eggert, and Godwin K. Vondolia

Abstract

Many resource users are not directly involved in the formulation and enforcement of resource management rules and regulations in developing countries. As a result, resource users do not generally accept such rules. Enforcement officers who have social ties to the resource users may encounter social disapproval and possible social exclusion from the resource users if they enforce regulations zealously. The officers, however, may avoid this social disapproval by accepting bribes. In this paper, we present a simple model that characterizes this situation and derives results for situations where officers are passively and actively involved in the bribery

Key Words: Natural resource management, bribery, law enforcement, social exclusion

JEF Classification: Q20, Q28, Z13

Contents

Enforcement of Exogenous Environmental Regulations, Social Disapproval, and Bribery

Wisdom Akpalu, Håkan Eggert, and Godwin K. Vondolia[*]

Introduction

Public policies—for example, environmental policies—seek to promote efficiencies in resource allocation. As a result, regulations are implemented to realign individual incentives with optimum social welfare. However, in spite of the implementation of a plethora of environmental management policies, the environmental resources in many countries are in danger of extinction and irreversible regime shift. (See FAO [2004] and Pauly et al. [1998] for illustrations with fisheries resources.) In developing countries, these regulations are hardly enforced due to the weakness of the institutions responsible for making and enforcing regulations. Consequently, the natural resource abundance in these countries has failed to reverse their economic problems.

Notably, weak institutional quality breeds corruption and noncompliance with resource appropriation rules and these remain a dominant explanation for the inefficient use of natural resources (Mehlum et al. 2006; Akpalu 2008; Eggert and Lokina 2008). The lax regulatory environment for the enforcement of environmental regulations creates an environment in which the regulations are not optimally enforced and resource users do not comply with them. Jentoft (1989) highlighted certain factors that are required for successful compliance with regulations, such as the content of the regulations, distributional impact of their effects, and design and implementation of the regulations. In the absence of any of these factors, resource users may consider the regulation illegitimate. For example, among 310 skippers who were interviewed in a fishing community where the fish stock is overharvested, only 11 percent of the respondents agreed that mesh-size regulation imposed by the government is "a right thing" (Akpalu 2008).

Recent research findings have established that resource users' perceived legitimacy of resource appropriation rules matters for compliance (see, e.g., Kuperan and Sutinen 1994; Akpalu 2008; Eggert and Lokina 2008). As a result, regulations imposed by an external authority suffer from higher rates of violation, relative to rules formulated and enforced by resource users themselves in many developing countries (see, e.g., Gebremedhin et al. 2003). For example, in Africa, state regulation of natural resources has had little success (Moorehead 1989; Shepherd 1991; Brinkerhoff 1995; Williams 1998). On the other hand, devolving resource management rights to local communities, coupled with effective internal governance, usually improves legitimacy and consequently increases compliance (see, e.g., Tyler 1990; Swallow and Bromley 1995; Turner, Pearce, and Bateman 1994; Gebremedhin et al. 2003). According to Tyler (1990), acceptance of the legitimacy of an authority encourages compliance with its laws even where those laws conflict with an individual's self-interest.

Bromley (1991) noted that the introduction of state property regimes to address resource degradation in developing countries has weakened local customary regimes because resource users are often divorced from the conservation policies in the state formation. When state institutions are in charge of managing natural resources, the regulatory environments are weak and resource users do not comply with these regulations, causing harvests to exceed sustainable levels (FAO 2004; Pauly et al. 1998). In Brazil, it has been observed that during elections, mayors do not enforce logging regulations in the Amazon region. Moreover, the weak monitoring and enforcement of rules is mostly the result of institutional problems in the civil service. One reason is the inadequate pay, education, and equipment of forest guards and the fact that single unarmed guards often live in the villages they are supposed to control (Heltberg 2001).

While, in some cases, local authorities are reluctant to enforce regulations for fear of losing elections (as noted by Nkonya et al. 2008), the most common experience is that the agents appointed to enforce such exogenous regulations have social ties with the resource users and may suffer social disapproval if they zealously enforce the regulations. Social ties contribute to building social capital, which lubricates all kinds of informal contracts in developing countries. (See Woolcock and Narayan [2000] for a synthesis of the literature on social capital.) As a result, people care more about shame-based sanctions, such as social ostracism (Ostrom et al. 1992; Barr 2004). Granovetter (1985) observed that even strict economic transactions are embedded in social structures that influence the decisions and behavior of economic agents. This situation breeds corruption in natural resource management because the enforcement agent very often accepts bribes and overlooks violations.

As noted by Robbins (2000), corruption in natural resource management entails the use or overuse of community natural resources with the consent of a state agent or an enforcement officer, for instance. Corruption depends on trust among the parties involved and on social expectations that rules will be enforced in particular ways, and on none of the agents informing higher authorities. As a result, the relationship between individuals involved in corruption extends beyond monetary exchange (Robbins 2000). In addition, natural resource corruption is common in situations where officials have a monopoly over environmental goods; control of externalities, such as control of a significant tract of forestland; or exclusive rights to issue waste-dumping permits (Goudie and Stasavage 1998; Ostrom et al. 1993).

A number of theoretical models have been developed to explain corruption in natural resource management. These models essentially consider how corrupt policymakers are bribed by resource users to influence the resource-appropriation policymaking processes (see, e.g., Aidt 1998; Fredriksson 1997, 2003; Scheich 1999) and how the various political and administrative branches within which the design of environmental policy can be corrupted (Wilson and Damania 2005). Although these models have enriched our understanding of corruption in the policymaking process, theoretical research on corruption in enforcement, especially when enforcement officers have social ties with resource users, is scarce.

As noted by Nyborg (2003), if behavior is guided mainly by the desire for social acceptance, economic incentives have much weaker effects than predicted by the traditional economic model. In this paper, we extend the existing theoretical model of crime to fill this gap. We assume that an external authority mandates an enforcement agent, who may have social ties with resource users, to enforce resource-use regulations. Since these agents will incur social disapproval (e.g., social exclusion) if they strictly enforce the regulation, they may accept bribes and overlook noncompliance—a likely situation that may explain the far-from-complete enforcement of natural resource management laws in developing countries.

In this paper, we found first that the extent of the social disapproval determines the gap between the observed and efficient enforcement levels of effort. Second, if the enforcement officer does not decide on a bribe amount, but is offered a bribe voluntarily (i.e., passively involved in the bribery), the size of the bribe determines the level of effort that the officer will invest in enforcing the regulation. In addition, increased social disapproval, all other things being equal, would lead to an equilibrium situation, where offenders pay bribes and the enforcement effort is indeterminate (i.e., only-bribery equilibrium), and a consequent complete collapse of the enforcement of the regulation. Furthermore, if the officer decides on a bribe price or is actively involved in the bribery, the violator may offer a bribe that is less than the fine and the officer will

accept a bribe that is less than the fine. The rest of paper is organized as follows: section 1 presents the models, propositions, and proofs, and section 2 concludes the paper.

1. The Model

In this section, we first present a simple utility maximization problem for which utility depends on leisure, consumption of composite good, and social disapproval from rule enforcement. Second, we extend the problem to include the possibility of a violator bribing the enforcement officer. Two bribing situations are considered: one, if the enforcer does not decide on a bribe amount (i.e., the bribe is exogenous since the officer is only passively involved in the bribery); and two, the officer decides on a bribe price (i.e., the bribe is endogenous since the officer decides on the bribe). Moreover, given that the officer decides on the bribe amount, we derive a condition under which the violator may pay a bribe and the officer may accept such a bribe.

1.1 Resource Management Rule Is Enforcement Officer's Problem

Suppose a natural resource management–law enforcement officer (i) derives utility from consuming a composite good (c) and leisure (l), but derives disutility from social disapproval for enforcing the law ($S(E)$), which depends on enforcement effort—for example, a certain number of inspections or certain amount of time spent on inspections—(E) within a period of time. In addition, suppose the number of inspections or time spent on inspections is directly related to the number of arrests. The total time endowment of the officer is L, so that $l = L - E$. Assume that the utility is of a Cobb-Douglas form, i.e., consumption, leisure, and enforcement effort are all essential to utility and appear in positive amounts for any utility larger than zero. In order to make it more analytically tractable, we used the specific functional form of the logarithmic transformation of the Cobb-Douglas utility function:

$$u^i\left(c, l, s\left(E\right)\right) = \alpha \ln c + \beta \ln\left(L - E\right) - \theta \ln E \ , \tag{1}$$

where $\theta \le \alpha, \beta$. Suppose that the officer can choose the level of enforcement effort (e.g., working full time or part time). For tractability, let E be a continuous variable and $g(E)$ be a function that defines the benefit received by the officer for the effort the officer invests in enforcing the regulation. The benefit function may not necessarily be linear because the officer could be rewarded for the quantity, as well as efficient use of his effort. However, for simplicity, but without losing generality, let w denote a constant marginal private benefit of increased effort (hereafter, a wage rate) and p_c be the fixed price of the composite good, so that the officer's

budget constraint is $wE \geq p_c c$. The officer's objective will be to maximize the utility function (equation [1]), with respect to E and c, subject to the budget constraint. The corresponding Lagrangian function is:

$$\ell = \alpha \ln c + \beta \ln(L - E) - \theta \ln E + \lambda(wE - p_c c) , \tag{2}$$

where λ is the Lagrangian multiplier. The first order conditions are:

$$\frac{\partial \ell}{\partial E} = -\beta(L - E)^{-1} - \theta E^{-1} + \lambda w = 0 , \tag{3}$$

$$\frac{\partial \ell}{\partial c} = \alpha c^{-1} - \lambda p_c = 0 , \text{ and} \tag{4}$$

$$\frac{\partial \ell}{\partial \lambda} = wE - p_c c = 0 . \tag{5}$$

From equation (3), in equilibrium, the marginal benefit from increased enforcement effort (λw) should equate the marginal cost of the increased effort ($\beta(L - E)^{-1} + \theta E^{-1}$). The marginal cost is the sum of the disutility from decreased leisure ($\beta(L - E)^{-1}$) and the disutility from social disapproval (θE^{-1}). Second, from equation (4), the marginal utility from the consumption of the composite good (αc^{-1}) must reflect the utility of the price of the good (λp_c). Solving for the equilibrium enforcement effort (E^*) from equations (3), (4), and (5) gives:

$$E^* = L(\alpha - \theta)(\alpha + \beta - \theta)^{-1} . \tag{6}$$

Proposition 1

The divergence between equilibrium enforcement efforts, with and without the possibility of social disapproval, increases with the degree of social exclusion, but decreases in the proportional change in utility with respect to the composite good (α).

Proof: In the absence of social disapproval ($\theta = 0$), the optimum effort level is given by $E^\circ = L\alpha(\alpha + \beta)^{-1}$. Therefore, the difference in the two effort levels is:

$$\Delta E = E^\circ - E^* = \frac{\beta \theta L}{(\alpha + \beta)(\alpha + \beta - \theta)} . \tag{7}$$

Taking the first order derivative of equation (7) with respect to θ and α, we obtain the signs $\frac{\partial(\Delta E)}{\partial \theta} > 0$ and $\frac{\partial(\Delta E)}{\partial \alpha} < 0$. (The partial derivatives are in the appendix.) The first

($\frac{\partial(\Delta E)}{\partial \theta} > 0$) indicates that the more social disapproval the officer encounters from the resource users, the less effort the officer will devote to enforcing the rules. Perhaps a more surprising finding is that the officer will increase enforcement effort if the proportional change in the utility of consumption of the composite good (α) increases. The intuition is that if the officer receives increased utility from consuming the composite good, the officer will need increased income to finance the consumption of the composite good. As a result, the officer has to increase enforcement effort to obtain an increase in income. Furthermore, without the possibility of bribery, if the officer encounters social disapproval for enforcing the rules, then increased wages or incentives will not affect enforcement effort ($\frac{\partial(\Delta E)}{\partial w} = 0$).

1.2 Bribing the Enforcement Officer and Acceptance of Bribe

Suppose that the law enforcement officer can accept a bribe (B) to avoid social disapproval from enforcing the law, but derives disutility from the shame associated with accepting a bribe. Let the shame or psychic disutility function be $v(B) = -\kappa B$, where $\kappa < \theta$. Note that the officer does not decide on the bribe price, so we assume that B is *exogenous* in the officer's optimization program. If the bribery is detected, the officer loses his job and income. The subjective probability of getting away with the bribe is $q(B) \in (0,1)$, with $q_B(B) < 0$ and $q(\infty) \to 0$ (i.e., the officer is more likely to get away with a lower bribe than a higher one). The objective of the agent is to maximize the following expected utility function:

$$\underset{c,l,E}{Max}\ \mathsf{E}\left\{u^j\left(c,l,s(E),v(B)\right)\right\} = \alpha \ln c + \beta \ln(L - E) - \theta \ln E - \kappa B\ , \tag{8}$$

subject to:

$$q(B)wE + B \geq p_c c\ . \tag{9}$$

The left hand side of equation (9) is the expected benefit that the officer obtains if the officer gets away with the bribe. Since the officer does not decides on the bribe price, B is not a choice variable in the officer's objective function. The Lagrangian function is:

$$\ell = \alpha \ln c + \beta \ln(L - E) - \theta \ln E - \kappa B + \mu\left(B + q(B)wE - p_c c\right)\ . \tag{10}$$

The first order conditions are:

$$\frac{\partial \ell}{\partial E} = -\beta (L - E)^{-1} - \theta E^{-1} + \mu q(B)w = 0 \ , \tag{11}$$

$$\frac{\partial \ell}{\partial c} = \alpha c^{-1} - \mu p_c = 0 \ , \text{ and} \tag{12}$$

$$\frac{\partial \ell}{\partial \mu} = B + q(B)wE - p_c c = 0 \ . \tag{13}$$

From equation (11), the expected marginal benefit of increased enforcement effort ($\mu q(B)w$) depends on the probability of getting away with the bribe. Assuming that $q(B) = e^{-\phi B}$ and solving the first order conditions (equations [14], [15], and [16]) gives a quadratic solution of:

$$E^* = \frac{Be^{\phi B}(B - \theta) + wL(\theta - \alpha)}{\left(2w(\theta - \alpha - \beta)\right)} \pm \frac{\left(\alpha wL - w\theta L + \theta Be^{\phi B} - B^2 e^{\phi B}\right)^2 - 4Be^{\phi B}L\theta w(\theta - \alpha - \beta)^{0.5}}{\left(2w(\theta - \alpha - \beta)\right)} \tag{14}$$

where $E^* = E_1, E_2$, of which one is admissible.

Proposition 2

An increase in the wage rate increases the bribe necessary to plunge the system into only-bribery equilibrium.

Proof: Note that the only-bribery equilibrium refers to a situation where the enforcer accepts the bribe and invests unpredictable amount of effort in enforcing the regulation. The proof for proposition 2 requires solving for B at the bifurcation point of the only-bribery equilibrium from equation (14), and then solving and signing the expression $\frac{\partial B}{\partial w}$. As shown in the appendix (equations 2A, 2B, and 2C), equating the two arms of the equation (14)—i.e., equating E_1 and E_2—solving for B, and taking the derivative give $\frac{\partial B}{\partial w} > 0$. This implies that if the officer's wage increases, a higher bribe price is necessary to collapse of enforcement of the regulation.

To illustrate these relationships, we plotted the solution for B (equation [2C] in the appendix) using the following parameters values assumed for convenience: $\alpha = 0.3$, $\phi = 0.1$,

$\beta = 0.2$, $\theta = 0.2$, $v = 20$, $w = 10$, and $L = 100$. Figure 1 shows the equilibrium relationship between the bribe amount and effort based on some chosen parameter values. The inner curve shows that the equilibrium relationship between the optimal effort and the bribe price has a flipping point beyond which the system falls into only-bribery equilibrium. An increase in the wage rate to $w = 20$ implies that the bribe amount that could plunge the system into the only-bribery equilibrium is much higher than before. This is shown by the second (outer) curve.

Figure 1. Equilibrium Relationship between Bribe and Effort:
Higher Wages ($w_2 > w_1$) Increases the Turning Point of the Graph
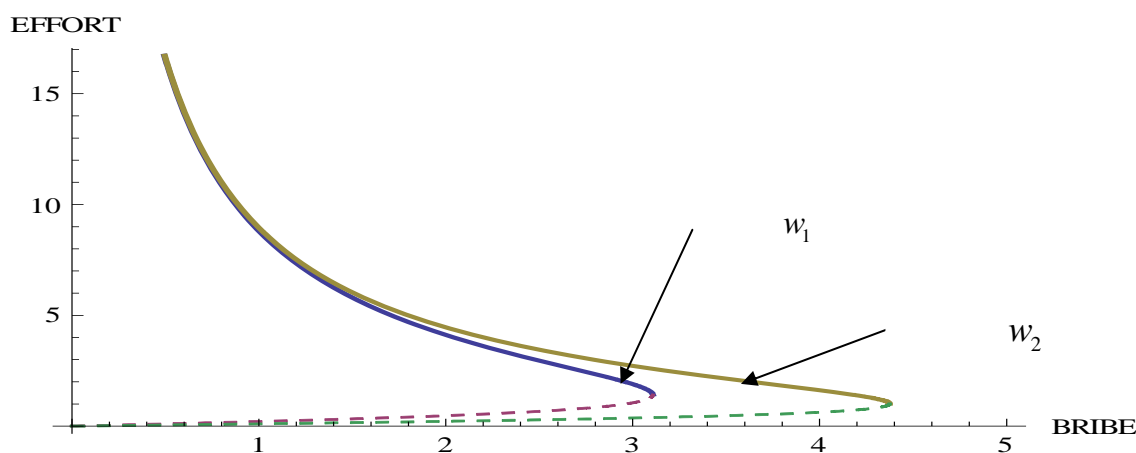
Thus, if the bribe is large enough, the enforcement officer will exert unpredictably low levels of effort in enforcing the regulation. This would invariably intensify noncompliance with the regulation. Note that we have presented the dashed segments of the curves in order to show that the curves have flipping points, but not to indicate a positive relationship between optimum effort and bribery, which is not admissible. From the foregoing analyses, it is therefore not surprising that in many developing countries a significant correlation exists between the bribery and violation rates of resource-appropriation rules.

In the following subsection, we present some basic empirical results to substantiate this claim. However, as can be seen in figure 1, by increasing the wage rate, the bifurcation point increases. This means that, as wages increase or if compensation packages increase, enforcement increases and it takes relatively larger bribes to plunge the system into only-bribery equilibrium. Furthermore, if it is possible for the officer to be bribed voluntarily, then for any given level of

the probability of detection of the bribery it is possible to determine the size of incentive (e.g., wage increases) that could mitigate the impact of the social disapproval.

1.3 A Numerical Illustration of the Relationship between Bribery and Rate of Violation

To illustrate the positive relationship between bribery and the rate of violation of a resource appropriation law, we used data from Eggert and Lokina (2008) on the violation of mesh-size regulation in artisanal fisheries in Tanzania,[1] gathered from interviews with 459 skippers using a questionnaire. In response to the declining catch per unit effort, some gill-net fishermen (who targeted Nile perch, tilapia, or dagaa) used nets with illegal mesh sizes to increase their landings. The rate of violation was computed as the proportion of the fishermen at each beach who indicated that they violated the regulation. The *bribery* variable was the proportion of violators who ever bribed the enforcement officer.

From the ordinary least square results presented in table 1, the rate of violation is regressed on bribery and regional dummy variables. The rates of violation and bribery are positively related, after controlling for regional differences. An approximately 3-percent increase in bribery will increase the rate of violation by 1 percent. This relationship conversely lends support to our theoretical prediction that increased bribery will lead to an increase in violation rate through of lower enforcement effort.

---

[1] Data was collected from 21 beaches in three regions (Kagera, Mwanza, and Mara) along the Tanzanian part of Lake Victoria in April–June 2003.

Table 1. Ordinary Least Square Estimation of the Relationship between Rate of Violation and Bribery

Variable	Coefficient	t-stat
Bribery	**2.92137**	(1.76)*
MARA[1]	**19.35052**	(1.95)*
KAGERA[1]	-3.92292	(-0.57)
Constant	**20.75432**	(3.83)***
Observations	21	
R-squared	0.31	

Notes: Robust t-stats are in brackets. *, **, *** significant at 10%, 5%, 1%, respectively.
[1] MWANZA is the reference region.

1.4 Demand for a Bribe: The Enforcement Officer Decides the Bribe Price

Suppose that the law enforcement officer decides the bribe price, if the illegal activity is detected. Let the indirect utility function of the officer be $V^i\left(w, p_c, I_0\right)$, if the officer does not accept the bribe offered by the offender (where I_0 is a vector of all other constants in the utility function), and the corresponding indirect utility function be $V^j\left(w, p_c, I_0, B_d\right)$, if the officer accepts the bribe. Where $V^j > V^i$ and B_d, the bribe is taken. Furthermore, the bribe amount that the officer asks for depends on the amount of the fine (F), as well as the giver's psychic cost of guilt (z) for offering the bribe. Thus, if the psychic cost is perceived to be relatively high, for example, the officer would accept a relatively low bribe.

Suppose the officer does not know the exact psychic cost of guilt, but only the range ($z \in \left[\underline{z}, \overline{z}\right]$) and its probability distribution. Assume that the distribution is uniform. Define the probability that the violator will offer a given amount of bribe requested by the officer as:

$$\Phi(z < F - B_d) = \frac{F - B_d - \underline{z}}{\overline{z} - \underline{z}} \ , \tag{15}$$

where F is a fixed legal fine for violating the regulation, so that the probability that the offender does not offer the bribe is:

$$1 - \frac{F - B_d - \underline{z}}{\overline{z} - \underline{z}} \Leftrightarrow \frac{\overline{z} - F + B_d}{\overline{z} - \underline{z}} \ . \tag{16}$$

The officer will therefore maximize the following expected utility function:

$$\underset{B_d}{Max} \ E(\Gamma) = \frac{\overline{z} - F + B_d}{\overline{z} - \underline{z}} \left[V^i (w, p_c, I_0) \right] + \frac{F - B_d - \underline{z}}{\overline{z} - \underline{z}} \left[V^j (w, p_c, I_0, B_d) \right] \ . \tag{17}$$

The first order condition from equation (17) is:

$$\frac{\partial E(\Gamma)}{\partial B_d} = \frac{V^i}{\overline{z} - \underline{z}} + \frac{F - B_d - \underline{z}}{\overline{z} - \underline{z}} V_B^j - \frac{V^j}{\overline{z} - \underline{z}} = 0 \ . \tag{18}$$

Proposition 3

The enforcement officer will accept a bribe that is less than the legitimate fine ($B_d < F$).

Proof: By rearranging equation (18), we have:

$$V^i + (F - B_d - \underline{z}) V_B^j - V^j = 0 \tag{19}$$
, and

$$B_d = F - \underline{z} - \rho(B) \tag{20}$$
,

where $\rho(B) = (V^j - V^i)(V_B^j)^{-1}$; hence, $B_d < F$.

Suppose a resource user obtains a benefit of π from an illegal harvest. If caught, the resource user could either bribe (B_s) the enforcement officer or pay some fixed fine (F) to the court (i.e., a legitimate fine). Furthermore, suppose that the offending resource user incurs z (i.e., some psychic cost of guilt) if the user offers the bribe to the officer. Let $m(B)$, with $m_B > 0$, define the probability that the bribe will be accepted by the enforcement officer. Consequently, if the resource user is caught by the officer, the user will offer a bribe if the following condition holds:

$$u(\pi - F) \le m(B) u^i (\pi - B_s - z) + (1 - m(B)) u^j (\pi - F - z) \tag{21}$$
.

If the user is an expected utility maximizer, the user's objective will be to maximize the term at the right hand side of equation (21). Thus:

$$\underset{B}{Max} \ E(\Omega) = m(B) u^i (\pi - B - z) + (1 - m(B)) u^j (\pi - F - z) \tag{22}$$
.

Taking the first order condition from equation (22) and rearranging gives:

$$\varepsilon\left(u^i - u^j\right) = -u_B^i B_s \quad , \tag{23}$$

where $\varepsilon = \dfrac{m_B}{m(B)} B$ defines the elasticity of the probability of acceptance of the bribe with respect to the bribe price. From equation (23) in equilibrium, the expected marginal utility gained from paying the bribe price rather than paying the legal fine ($\varepsilon\left(u^i - u^j\right)$) must be equal to the marginal disutility of the bribe price paid ($-u_B^i B_s$).

Proposition 4

If the illegal fisherman is risk neutral, the fisherman will offer a bribe that is less than the fine ($B_s < F$), if $\varepsilon \in \left(0, \infty\right)$, and the bribe will increase in ε and F.

Proof. Assume for simplicity that the resource user (e.g., the fisherman) is risk neutral, so that $u^i = \pi - B_s - z$ and $u^j = \pi - F - z$:

$$\varepsilon\left(F - B_s\right) = B_s \quad \text{, and} \tag{24}$$

$$B_s = \left(\frac{\varepsilon}{1+\varepsilon}\right) F \quad . \tag{25}$$

For all $\dfrac{\varepsilon}{1+\varepsilon} \in (0,1)$, $B_s < F$. Taking the comparative statics of equation (25) with respect to the two arguments, we have $\dfrac{\partial B_s}{\partial \varepsilon} > 0$ and $\dfrac{\partial B_s}{\partial F} > 0$, implying that that the violator will offer a higher bribe if the legitimate fine and the elasticity of the probability of acceptance of the bribe increase. (The derivation of the comparative statics is presented in the appendix.) In addition, for any given fine, the maximum amount that the violator will offer is the legitimate fine ($B_s = F$), since $\lim_{\varepsilon \to \infty} \to \left(\dfrac{\varepsilon}{1+\varepsilon}\right) = 1$. On the other hand, $\lim_{\varepsilon \to 0} \to \left(\dfrac{\varepsilon}{1+\varepsilon}\right) = 0$, therefore the violator will offer no bribe ($B_d = 0$), if the size of the bribe does not determine whether the officer will accept it or not.

1.5 Condition for Successful Bribery

In this section, the condition under which a bribe may be offered and received is deduced. This condition follows directly from equations (24) and (25).

Proposition 5

A bribe will be offered and will be accepted if $F \geq \dfrac{\rho(B) + \underline{z}}{(1-\sigma)}$.

Proof: The proof for this requires verifying the condition under which $B_s \geq B_d$. This implies that:

$$F\left(\frac{\varepsilon}{1+\varepsilon}\right) \geq F - \underline{z} - \frac{V^j - V^i}{v_B} \quad . \tag{26}$$

Equation (26) could be rewritten as:

$$F \geq \frac{\rho(B) + \underline{z}}{(1-\sigma)} \tag{27}$$
,

where $\sigma = \left(\varepsilon / (1+\varepsilon)\right)$. Equation (27) defines the bribery set and figure 2 presents a sketch of the bribery set. Furthermore, increasing the probability of the officer being detected receiving the bribe and being fired will increase $\rho(B)$ and consequently deter successful bribery. In addition, increasing the psychic cost (i.e., guilt $\underline{z}$) of bribing may deter successful bribery.

In figure 2, for any given level of B, there is a corresponding minimum level of F that is necessary for the bribe to be offered and accepted. Any F above the threshold (i.e., in the shaded area) engenders successful bribery.

**Figure 2. The Plot of the Equilibrium Relationship between Paying
a Legitimate Fine and Successful Bribery**
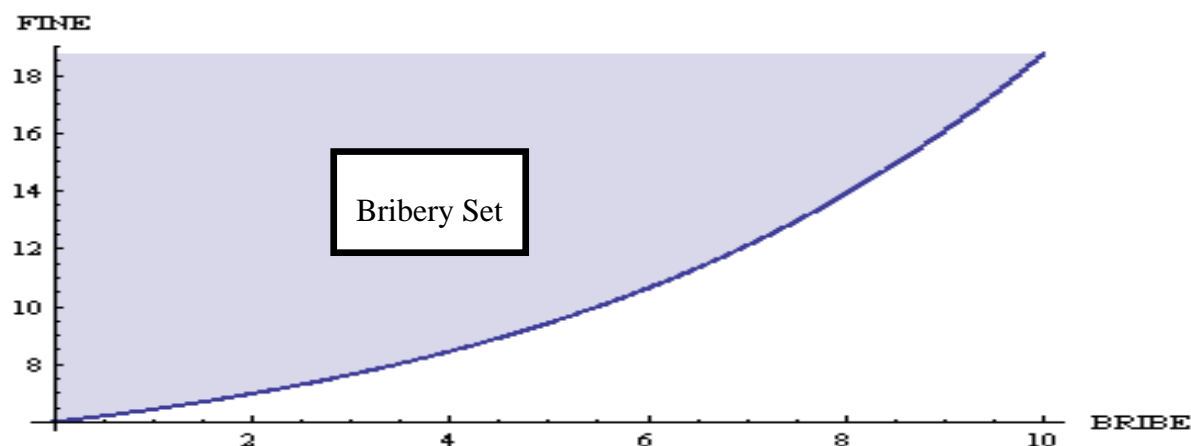
2. Conclusions

In this paper, a neoclassical utility maximization framework has been extended to incorporate social considerations that characterize the enforcement of natural resource management regulations in developing countries. Notably, natural resource management regulations are weakly enforced in developing countries, despite obvious resource degradation. There seem to be an inefficient equilibrium where resource users do not strictly comply with the laws. Also, government-appointed agents do not completely enforce these regulations, especially if they are likely to suffer social disapproval from enforcing the rules. This paper, therefore, develops a simple theoretical model to characterize this situation and derives some interesting policy outcomes.

Our theoretical model produces key propositions for describing the behavior of law enforcement officers and their strategic interaction with communities where they are required to enforce these environmental regulations. We found that the divergence between equilibrium enforcement effort, with and without the possibility of social disapproval, increases with the degree of social exclusion, but decreases in the proportional change in utility with respect to the composite good. Thus, in communities where the social exclusion is higher, there will be greater divergence between the actual and desirable enforcement effort levels. This finding is consistent with the notion that if behavior is guided mainly by the desire for social acceptance, then economic incentives will have much weaker effects than predicted by the traditional economic models. In addition, if the proportional change in utility with respect to the composite good is

higher, there will be less distinction between the effort levels. Furthermore, if the wage rate increases, the bribe that could plunge the system into only-bribery equilibrium has to be higher. Thus, higher wages offered to government-appointed agents who enforce the environmental regulations could increase enforcement effort. Finally, the government-appointed agent will accept bribes that are less than the legitimate fine. On the other hand, if the resource user is risk-neutral, the user may also offer a bribe that is less than the fine that would have to be paid to the law court.

References

Aidt, T.S. 1998. Political Internalization of Economic Externalities and Environmental Policy. *Journal of Public Economics* 69, 1–16.

Akpalu, W. 2008. Fishing Regulations, Individual Discount Rate, and Fisherman Behavior in a Developing Country Fishery. *Environment and Development Economics* 13(5): 565–87.

Barr, A. 2004. Forging Effective New Communities: The Evolution of Civil Society in Zimbabwean Resettlement Villages. *World Development* 32(10): 1753–66.

Becker, G.S. 1968. Crime and Punishment: An Economic Approach. *Journal of Political Economy* 76(2): 169–217.

Brinkerhoff, D.W. 1995. African State-Society Linkages in Transition: The Case of Forestry Policy in Mali. *Canadian Journal of Development Studies* 16: 201–228.

Bromley, D. 1991. *Environment and Economy: Property Rights and Public Policy*. Cambridge: Blackwell.

Ding, N., and B.C. Field. 2005. Natural Resource Abundance and Economic Growth. *Land Economics* 81: 496–502.

Eggert, H., R.B. Lokina. 2008. "Regulatory Compliance in Lake Victoria Fisheries." RFF/EfD Discussion Paper 08-14. Washington, DC, and Gothenburg, Sweden: Resources for the Future and Environment for Development.

FAO (United Nations Food and Agriculture Organization) Fisheries Department. 2004. State of the World Fisheries and Aquaculture 2004. Rome: FAO.

Fredriksson, P.G. 1997. The Political Economy of Pollution Taxes in a Small Open Economy. *Journal of Environmental Economics and Management* 33: 44–58.

———. 2003. Political Instability, Corruption, and Policy Formation: The Case of Environmental Policy. *Journal of Public Economics* 87: 1383–1405.

Gebremedhin, B., J. Pender, and G. Tesfay. 2003. Community Natural Resource Management: The Case of Woodlots in Northern Ethiopia. *Environment and Development Economics* 8: 129–48.

Goudie, A.W., and D. Stasavage. 1998. A Framework for the Analysis of Corruption. *Crime, Law, and Social Change* 29: 113–59.

Granovetter, M. 1985. Economic Action and Social Structure: The Problem of Embeddedness. *American Journal of Sociology* 91: 481–510.

Heltberg, R. 2001. Determinants and Impact of Local Institutions for Common Resource Management. *Environment and Development Economics* 6: 182–208.

Isham, J., M. Woolcock, L. Pritchett, and G. Busby. 2005. The Varieties of Resource Experience: Natural Resource Export Structures and the Political Economy of Economic Growth. *World Bank Economic Review* 19(2): 141–74.

Jentoft, S. 1989. Fisheries Co-management: Delegating Government Responsibility to Fishermen's Organizations. *Marine Policy* 13(2): 137–54.

Kuperan, K., and J.G. Sutinen. 1994. Compliance with Zoning Regulations in Malaysian Fisheries. Paper presented at the 7th Conference of the International Institute of Fisheries, Economics, and Trade, Taipei, Taiwan, July 18–21, 1994.

Mehlum, H., K. Moene, and R. Torvik. 2006. Institutions and the Resource Curse. *Economic Journal* 116: 1–20.

Moorehead, R. 1989. Changes Taking Place in Common Property Resource Management in the Inland Niger Delta in Mali. In *Common Property Resources: Ecology and Community-Based Sustainable Development*, edited by F. Berkes. London: Bellhaven.

Nkonya, E., J. Pender, and E. Kato. 2008. Who Knows, Who Cares? The Determinants of Enactment, Awareness, and Compliance with Community: Natural Resource Management Regulations in Uganda. *Environment and Development Economics* 13: 79–101.

Nyborg, K. 2003. The Impact of Public Policy on Social and Moral Norms: Some Examples. *Journal of Consumer Policy* 26: 259–77.

Ostrom, E., R. Gardener, and J. Walker. 1992. Covenants with and without the Sward: Self-Governance is Possible. *American Political Science Review*, 86, 404–17.

Ostrom, E., L. Schroeder, and S. Wynne. 1993. *Institutional Incentives and Sustainable Development*. Boulder, CO, USA: Westview Press.

Pauly, D., V. Christensen, J. Dalsgaard, R. Froese, and F.C. Torres Jr. 1998. Fishing down Marine Food Webs. *Science* 279: 860–63.

Robbins, P. 2000. The Rotten Institution: Corruption in Natural Resource Management. *Political Geography* 19: 423–43.

Schleich, J. 1999. Environmental Quality with Endogenous Domestic and Trade Policies. *European Journal of Political Economy* 15: 62–71.

Shepherd, G. 1991. The Communal Management of Forests in the Semi-arid and Sub-humid Regions of Africa: Past Practice and Prospects for the Future. *Development Policy Review* 9: 151–76.

Swallow, B., and D. Bromley. 1995. Institutions, Governance, and Incentives in Common Property Regimes for African Rangelands. *Environment and Resource Economics* 5: 1–20.

Turner, K., D. Pearce, and I. Bateman. 1994. *Environmental Economics: An Elementary Introduction*. New York: Harvester Wheatsheaf.

Tyler, T. R., 1990. *Why People Obey the Law*. New Haven, CT, USA: Yale University Press.

Williams, T. O. 1998. Multiple Uses of Common Pool Resources in Semi-arid West Africa: A Survey of Existing Practices and Options for Sustainable Resource Management. Natural Resource Perspectives. London: Overseas Development Institute.

Wilson, J.K., and R. Damania. 2005. Corruption, Political Competition, and Environmental Policy, *Journal of Environmental Economics and Management* 49, 516–35.

Woolcock, M., and D. Narayan. 2000. Social Capital: Implications for Development Theory, Research, and Policy. *World Bank Research Observer* 15: 225–49.

Appendix

Proposition 1

Recalling equation (7), we have:

$$\Delta E = \frac{\beta \theta L}{(\alpha + \beta)(\alpha + \beta - \theta)} \ . \tag{1A}$$

Taking the first order derivative of equation (1A) with respect to θ and α, equations (1B) and (1C) are obtained:

$$\frac{\partial (\Delta E)}{\partial \theta} = \frac{(\alpha + \beta)(\alpha + \beta - \theta)\beta L + (\alpha + \beta)\beta \theta L}{\left((\alpha + \beta)(\alpha + \beta - \theta)\right)^2} > 0 \tag{1B}$$

$$\frac{\partial (\Delta E)}{\partial \alpha} = \frac{\beta \theta (\theta - 2\alpha - 2\beta) L}{\left((\alpha + \beta)(\alpha + \beta - \theta)\right)^2} < 0 \ . \tag{1C}$$

Proposition 2

From equation (17):

$$E_1 = \frac{Be^{\phi B}(B - \theta) + wL(\theta - \alpha) + \left(\left(\alpha wL - w\theta L + \theta Be^{\phi B} - B^2 e^{\phi B}\right)^2 - 4Be^{\phi B}L\theta w(\theta - \alpha - \beta)\right)^{0.5}}{\left(2w(\theta - \alpha - \beta)\right)}$$

$$\tag{2A}$$

$$E_2 = \frac{Be^{\phi B}(B - \theta) + wL(\theta - \alpha) - \left(\left(\alpha wL - w\theta L + \theta Be^{\phi B} - B^2 e^{\phi B}\right)^2 - 4Be^{\phi B}L\theta w(\theta - \alpha - \beta)\right)^{0.5}}{\left(2w(\theta - \alpha - \beta)\right)}$$

$$\tag{2B}$$

Equating equations (2A) and (2B) give the following equation for the bifurcation point:

$$\left(\alpha wL - w\theta L + \theta Be^{\phi B} - B^2 e^{\phi B}\right)^2 - 4Be^{\phi B}L\theta w(\theta - \alpha - \beta) = 0 \tag{2C}$$

Taking the partial derivative of the implicit function (i.e., equation 2C) gives $\partial B / \partial w > 0$.

Proposition 3

From equation 23, $B_d = F - \underline{z} - \rho(B)$, where $\rho(B) = \left(V^j - V^i\right)\left(V_B^j\right)^{-1}$. From the specific

preferences, $\rho(B) = \left(\theta \ln\left(E_i^*/E_j^*\right) - \alpha \ln\left(c_i^*/c_j^*\right) - \beta \ln\left(l_i^*/l_j^*\right) - \kappa B^*\right)\Big/\left(\kappa - \lambda\left(wE_j^* P_B + 1\right)\right)$, where

$E_i^* > E_j^*$, $c_j^* > c_i^*$ and $l_j^* > l_i^*$. In addition, from the envelop theorem,

$V_B^j = \left(\kappa - \lambda^*\left(wE_j^* P_B + 1\right)\right) > 0$. Since all the terms of the numerator, except the last term, are

positive, ρ will be positive for low values of κ, hence $B_d < F$.

Proposition 4

From the resource officer's expected utility function (i.e., equation [26]), the first order

condition with respect to the bribe is:

$$\frac{\partial E\left(\Omega\right)}{\partial B} = m_B u^i + m(B)u_B^i - m_B u^j = 0 \tag{4A}$$

$$\frac{m_B}{m(B)}\left(u^i - u^j\right) = -u_B^i \tag{4B}$$

which is $\varepsilon\left(u^i - u^j\right) = -u_B^i B_s$, where $\varepsilon = \dfrac{m_B}{m(B)}B$. Assuming risk neutrality that $u^i = \pi - B_s - z$,

$u^j = \pi - F - z$ and $B_s = \left(\dfrac{\varepsilon}{1+\varepsilon}\right)F$. Therefore:

$$\frac{\partial B_s}{\partial \varepsilon} = \frac{1}{\left(1+\varepsilon\right)^2} > 0 \text{ and } \frac{\partial B_s}{\partial F} = \left(\frac{\varepsilon}{1+\varepsilon}\right) > 0. \tag{4C}$$