

Environment for Development

Discussion Paper Series

March 2009 ■ EFD DP 09-08

Optimal Enforcement and Practical Issues of Resource Protection in Developing Countries

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Abstract

This paper relates the key findings of the optimal economic enforcement literature to practical issues of enforcing and managing forest and wildlife access restrictions in developing countries. Our experiences, particularly in Tanzania and southern India, detail the major pragmatic issues facing those responsible for protecting natural resources. We identified large gaps in the theoretical literature that limit its ability to inform practical management, including issues of limited funding and cost recovery, multiple layers of enforcement, different incentives faced by those responsible for enforcement, and conflict between protected-area managers' job requirements and rural people's needs.

Key Words: optimal enforcement, protected-area management, non-timber forest products, conflict, India

JEL Classification: K42, Q23, Q34

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Introduction

In many developing countries, forest management is shifting from an adversarial approach, in which governments exclude local communities from publicly-owned forests, toward more cooperative management regimes, where communities participate in the management and even ownership of forests and wildlife. The aims of such a shift toward participatory community management of resources include greater accountability, reduced conflict, and—ideally—both improved livelihoods and better protected resources. Yet, even with community-based management, some level of enforcement is almost inevitably required against poaching and other illegal uses of forest and park resources (Clark et al. 1997). Despite a substantial and well-developed law and economics literature on optimal enforcement and despite considerable research addressing the management of natural resources in developing countries, few papers attempt to link the insights from the optimal enforcement literature to the protection of forest and wildlife resources in these countries. Similarly, little practical experience in enforcing regulations in parks and forests in developing countries informs the optimal enforcement literature.

In this paper, we assess key findings in the optimal enforcement literature with respect to issues of practical policy concern for forest and wildlife protection in developing countries. We base our discussion on observations from numerous countries, but many of our examples come from our experiences with forest management in the state of Orissa in southern India (where one of the authors was a forest official) and Tanzania, where participatory forest management (PFM) is being introduced and many enforcement issues remain unresolved. Our examples detail the major pragmatic issues facing those responsible for protecting natural resources, where funding

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is limited and where the local people rely heavily on illegal extraction of resources within protected areas.

In section 1, we address three of the key themes that have been a focus of much the optimal enforcement literature since Becker's 1968 seminal paper: 1) why fines are not simply set as high as possible, 2) assumptions about the objective function of the enforcement agent, and 3) why the emphasis of the literature is on incomplete rather than full enforcement. We compare the findings of the literature with our empirical evidence, including the amount of fines and the size of enforcement budgets. Because conservation biologists and policy makers may feel that the full protection of a particularly endangered species is essential, we explore the extent to which the literature can inform the implementation of such "full enforcement" mandates. Although understanding these aspects of optimal enforcement is critical for designing practical enforcement strategies, the literature marginalizes many issues that are critical for developing countries. In section 2, we look closely at a number of these issues, including multiple tiers of enforcement—where individuals in each tier often have different objectives, conflicts, and limited funds for enforcement. Section 3 concludes with a discussion of areas where developments in the literature could help to inform practical protected-area policy.

1. Key Issues Addressed in the Early Optimal Enforcement Literature

The fundamental questions for issues of law enforcement were posed by Becker (1968, 170), who, recognizing that enforcement is costly, asked "how many offences *should* be permitted and how many offenders *should* go unpunished" (emphasis in the original). Becker concluded that the greater the expected penalty (actual penalty multiplied by the probability of detection and punishment), the greater the deterrent effect on crime. Under a set of restrictive assumptions, Becker concluded that the optimal form of deterrence is to set fines as high as possible, while reducing the level of costly monitoring. The rationale behind Becker's argument was given succinctly by Malik (1990, 341): "...[r]aising the probability of a fine is costly, since it requires devoting more resources to monitoring and apprehending individuals [whereas] raising the magnitude of a fine is costless."

1.1 The Level of Fines

Following from Becker, the optimal enforcement literature identifies a number of reasons why fines should not simply be set as high as possible.¹ First, fines must typically be capped at the level of an individual's wealth. Second, large fines can encourage socially wasteful avoidance activities that reduce the probability that an individual will be caught and fined (see, for example, Malik 1990; Lear and Maxwell 1998). Third, fines considered excessive may not be politically viable (Rodriguez-Ibeas 2002). Fourth, if the notion of "fairness" of sanctions is included in analysis of optimal enforcement, then the optimal sanction is lower than would otherwise be predicted, although the corresponding probability of sanctions being imposed could be either higher or lower (Shavell and Polinsky 2000). Finally, when there is opportunity for bribery, higher official fines may simply result in greater incidence of bribe taking (Mookerjee and Png 1995). For a number of reasons, therefore, more recent theory predicts that the optimal level of enforcement is likely to require a relatively high probability of detection and relatively low fines, compared with the conclusions from the early optimal enforcement literature.

Fines for the illegal theft of resources from parks and forests in developing countries do appear to be low relative to social cost, particularly for wildlife. Fines may be so low that they do little, if anything, to deter illegal activities (Abbott and Mace 1999). For example, in Ghana, fines for hunting protected species, such as the civet cat (*Civettictis civetta*) or mona monkey (*Cercopithecus mona*), are GHC 10,000 (the old Ghanaian cedi), or approximately US\$ 1.14, at the prevailing exchange rate when the data was collected. However, the market prices for these species were about \$11 and \$13,² respectively, and the social values likely are much higher still (Ntiama-Baidu 1997; Damania et al. 2005). Given that average returns to hunting for farmers were approximately equal to the government daily wage in 1976—and 40 percent higher than average wages in 1993 (Ntiama-Baidu 1997)—and that the probability of being caught is low, few incentives encourage farmers to stop hunting or to discriminate over which species they hunt (Robinson 2008). In Malaysia, a court recently fined a man less than \$1,900 for possessing a tiger carcass, although it is worth many times more on the black market and, again, even more from society's perspective (*Animal Planet News* 2005).

¹ Without limits to the monetary amount that an individual can be penalized, any desired pattern of deterrence "could be achieved at minimal cost by combining arbitrarily low monitoring with sufficiently steep penalties" (Mookherjee and Png 1994, 1049), as proscribed by Becker (1968).

² Fines and currency conversion data are from 2003; see Damania et al. (2005).

In India, the civil jurisprudence has a rule of thumb that fines should be proportionate to the crime. Consequently, fines for illegal collection of fuelwood and forest fruits and vegetables are low, reflecting the low absolute values of the illegal acts to the perpetrators and their low levels of wealth. However, the additional ecological costs imposed on the habitat itself are typically unaccounted for when punishments are set and may be considerably higher. Fines for wildlife poaching in India are steeper, reflecting the perceived increased severity of the crime, but they are still low in absolute terms (authors' experience).

In richer countries, fines are more likely to “fit the crime,” in line with the theory. For example, in the United States, Colorado's “Samson Law” imposes heavy penalties for illegally killing trophy-class animals. The US\$ 10,000 fine for illegally killing a deer far exceeds the price of a single animal carcass in the market (Colorado Department of Natural Resources 2005). Some poorer countries are starting to increase fines significantly for high social-cost crimes; in Cameroon, for example, fines for hunting endangered species were increased to range from CFA 50,000 to 200,000—approximately \$100 to \$400 (Agnagna and Koutou 2001). These fines are still low compared to the social value of many of the species, but are high relative to the value to the poacher, which is typically the carcass value. Therefore, the deterrence effect of such fines, combined with a high enough probability of being caught, could be substantial. Yet, in general, the current reality in many developing countries is that fines are too low to deter many individuals from illegal activity—whatever the probability of being caught—even taking into account the costs associated with the illegal activity, such as the purchase of a gun for hunting or the time and distance cost of finding the resource (Abbot and Mace 1999).

A key reason why fines appear to be so low in many developing countries, and do little to discourage illegal activities, is that fines are not wealth contingent (which is consistent with the theoretical literature) and are instead capped at the wealth of the poorest individuals (Bar-Niv and Safra 2002). Given that the wealth of people living near protected areas in developing countries tends to be heterogeneous and that the vicinity also includes many very poor people, the fines may be relatively low and offer little disincentive to those who are not the poorest. The very poor, in turn—even if the fines are high relative to their wealth—may have few alternatives to the resources in the protected areas and so may continue to collect illegally whatever the punishment.

Because fines are typically low, as predicted in theory and as evident in practice, finding mechanisms to increase the effective cost to the perpetrator of illegal activities is a key priority for many developing countries, particularly where wealth-contingent fines are not feasible. Increasing the cost of the punishment for those who are successfully convicted can be achieved

with prison sentences, which impose a high cost for both the rural poor and wealthier individuals, as can confiscating contraband. But, the legal systems in many developing countries, such as India, operate slowly with low likelihood of successful conviction and imprisonment. This situation reduces the expected penalty, and thus the effectiveness of enforcement efforts, and use of prison sentences increases administrative costs.

The concept of an “enforcement chain” provides a useful starting point for analyzing explicitly each component of enforcement (Sutinen 1987; Akella and Cannon 2004). The effective deterrence of an enforcement regime is the product, not only of the fine and the probability of being detected, but also the subsequent steps of detection, arrest, prosecution, and conviction. Effectiveness is driven by the least effective of these processes and can only be improved by addressing each constraint in turn. Despite the difficulties with each link in this chain in developing countries, much of the literature still assumes that detection is costly and that prosecution, following detection, is perfect and without cost.

Even with low fines, we have observed widespread avoidance activities that reduce the probability of capture, but are socially wasteful. Such activities range widely in their cost to those illegally extracting forest resources or poaching wildlife, and thus in their impact on social welfare. During our fieldwork, we found that villagers in Thailand, China, Tanzania, and India reported simple and inexpensive avoidance activities, such as sending a child to determine whether forests guards have parked nearby and are likely to be patrolling, going out at night because rangers only patrol during the day, or waiting until a patrol has passed. On the other end of the cost scale, people poaching endangered and charismatic species, such as rhino in Africa, invest in high speed vehicles that enable fast escapes. Anecdotal evidence from our fieldwork suggests a strong empirical relationship between fines and costly avoidance activities that is not well developed in the theoretical literature. Further, our frequent observation of predictable ranger patrol routes, which are relatively easy to avoid, suggests that patrols should be more tactical; yet, again, there is little in the literature to inform such pragmatic situations.

1.2 The Enforcement Agency’s Objective Function

The optimal enforcement literature typically assumes that the agency responsible for enforcement aims to maximize one of three functions: social welfare—including returns to the illegal activity, returns only to legal activities, or profits. Although most of the literature focuses on optimizing social welfare, there have long been criticisms of it, particularly when the perpetrator of the crime gets positive utility, but society brands the crime illicit (Stigler 1970). Milliman (1986) discussed whether the government should optimize over all returns or only legal

returns and suggested that some value be attached to illegal fishing because the perpetrator gets utility from the theft. Clarke et al. (1993) pursued Milliman's idea by introducing a parameter to weight the illegal timber harvester's utility in the government's objective function. By parametrically varying this parameter, different combinations of "equity" and "efficiency" objectives can be considered (Robinson 1997). Less attention has been paid to the issue of private enforcement, in which a profit-maximizing enforcement agency aims to maximize fine revenue less the cost of enforcement. See, for example, Landes and Posner (1975), Polinsky (1980), and Garoupa (1997).

In practice, whether or not governments and protected-area managers incorporate the value of illegal activities in their decisions can lead to very different management strategies and raises serious concerns for equity where poor people rely directly on forest and park resources for a large fraction of their effective incomes (Cavendish 2000; Robinson et al. 2002; Albers and Robinson 2007). For example, in Tanzania, some community-based forest management (CBFM) and joint forest management (JFM) schemes legally allow rural people to collect forest resources—which was previously illegal—recognizing the importance of these resources to rural livelihoods and especially the rural poor. But, national regulations for JFM in government preservation forests mandate that no resources can be taken from these forests, even where villagers have traditionally used these resources and even where there are no alternatives. Such policies, although intended to protect forests with exceptional biodiversity, often fail to consider the ongoing livelihood needs of local people. In this respect, the discussion in the optimal enforcement literature of including illegal activities with positive social value in enforcement regimes is not necessarily reflected in practical forest policy and management. In part, this lack of attention to livelihood needs may occur when forest management is dominated by a conservation emphasis rather than consideration of livelihoods. Despite the formal rules, however, many of the protected-area managers we talked to in Thailand, India, and Tanzania understand the livelihood issues and have unofficial policies to allow collection of limited forest products for home use.

1.3 Full versus Incomplete Enforcement

Whether or not the returns to the illegal activity are included in the enforcement agency's objective function, a central result of the enforcement literature is that, when fines are capped

and detection or punishment of crime is costly—as is almost always the case—it is rarely optimal to prevent all illegal activity.³ Budget constraints simply reinforce this conclusion. Perhaps not surprisingly then, most of the optimal enforcement literature ignores full enforcement. Yet, whereas the optimal enforcement literature focuses almost exclusively on incomplete enforcement, many conservation biologists argue that, with respect to endangered species (particularly those with low rates of reproduction), a “precautionary principle” of zero illegal killing is the only option (Bowen-Jones et al. 2002). Moreover, zero tolerance of illegal activities is often mandated to protected-area managers, especially to maintain IUCN (International Union for Conservation of Nature) classifications of nature reserves or national parks.

There are few examples in practice of “perfect enforcement.” One is rhino poaching in Swaziland, which appears to have been eliminated through amendments to the Game Acts, which significantly increased the powers of rangers and police officers, and through the introduction of patrols with armed guards carrying automatic assault rifles (who work 24 hours per day, 7 days per week) and in continuous radio contact (CITES 2004). Mandatory minimum prison sentences are imposed upon those caught with endangered species, and individuals are not permitted to pay a fine to avoid a prison sentence (something that had been favored by richer poachers). Such measures are extreme and very costly (which raises the issues of who can and who should fund such activities, and who benefits from the protection), but have been enacted to protect highly endangered species where conservationists consider zero tolerance the only way to avoid local extinctions.⁴

Despite the focus of the optimal enforcement literature on incomplete enforcement, it still offers some clues as to how full enforcement might be achieved in specific species or areas of land. For example, the literature has long recognized that legalizing less-socially damaging activities can induce individuals to switch from more damaging actions. Robinson (2008) suggests that the full protection of endangered species is more likely and more cost effective if hunting less-endangered species is permitted.

³ That is, incomplete enforcement is an equilibrium under a broad range of parameters, either because marginal costs exceed the marginal benefits of moving toward full enforcement or because there is need for marginal deterrence to prevent criminals from committing worse crimes. As Helsley and Strange (1994, 293) demonstrated, if “marginal exclusion costs are positive, then there is always some illegal use in a subgame-perfect Nash equilibrium”; that is, it is “uneconomical to exclude all free riders unless marginal exclusion costs are zero.”

⁴ As a result, general poaching of rhino is reported to have been reduced by 90 percent.

Spatially-differentiated enforcement regulations could go some way towards reconciling the conservationists' desire for "perfect enforcement" with the practical realities of enforcement and the theoretical prediction that it is rarely optimal to prevent all illegal activity (Albers 2008). Yet, enforcement strategies in typical forest settings in developing countries are rarely spatial, and there is little in the optimal enforcement literature to inform such spatial strategies within a landscape. We find that forest managers typically spread patrols somewhat evenly across the forests, which results in incomplete and ineffective enforcement everywhere. From ecological and livelihoods perspectives, it might be more effective to protect a smaller area of forest better. From an economic efficiency perspective, it may be best to forego patrols in very remote areas, where villagers are unlikely to go, and to permit extraction in some outer "buffer zone" (Albers 2008; Robinson and Albers 2006). The resulting patterns of enforcement and extraction can produce regions of full or complete enforcement, regions of deterrence, and other regions of incomplete enforcement (Albers 2008).

2. Under-Researched Practical Aspects of Enforcement

In this section, we address key practical aspects of protected-area management that have received scant attention in the literature, yet are critical concerns in developing countries: sources of funding for enforcement activities, multiple layers of enforcement, equity, and conflict.

2.1 Enforcement Costs, Enforcement Budgets, and the Role of Fines

Not only are fines low in developing countries, but enforcement costs tend to be high. Enforcement of access restrictions in forests of developing countries, beyond atypical settings, is costly, in part because the areas are large and often dense with vegetation, but also because the number of resource-dependent people who enter these forests is large. Enforcement requires salaries for the guards who patrol large areas, in addition to the expenses of vehicles, guard stations, and other equipment. These costs form a significant fraction of many forest and park management budgets. In Thailand, guard and other enforcement costs make up the bulk of the annual budget for national parks (MIDAS Agronomics 1993, vol. 3). In India, approximately 60 percent of forest department budgets is spent on enforcement activities that include salary costs, travel costs, and protection infrastructure (authors' estimates). When there is little potential for tourism and recreation services, the enforcement costs rise as a percentage of budgets. Yet, with constraints on the amounts of fines, as predicted by the literature and as found in practice, those responsible for enforcement cannot simply reduce its costs and maintain its effectiveness by

lowering the probability of being caught—and therefore lowering the costs of detection—and increasing the fine proportionately.

In many developing countries, the budgets available for protecting key natural resources are negligible or even zero. Policies to involve local communities in the management of nearby resources through versions of CBFM or JFM attempt to obviate the need for large government-provided enforcement budgets. But, CBFM and JFM require access restrictions themselves—enforced by the villagers—which removes a cost for the government agency, but adds a social cost. For example, where JFM has been introduced in Tanzania, we found that village environmental committees are responsible for patrolling the forests, but there is no budget to remunerate them for their activities. The literature's focus on the socially optimal level of enforcement is therefore of little relevance. Indeed, the literature largely ignores where the enforcement budget comes from, whereas this question is often a central issue for a poor country. Forest and park managers in developing countries face a complicated situation where the total budget for protection is partially endogenous to policy decisions. They must focus on cost recovery—funding enforcement activities through hunting license fees, fines, and tourism gate fees—to augment exogenous budgets (Robinson 2008).⁵

Where there are charismatic species, cost recovery is more likely feasible (Robinson 2008). For example, the Tanzanian government in 1990 earned US\$ 4.5 million from “trophy” hunting licenses and \$1.9 million from the national parks system (Makombe 1994). Similarly, although the parastatal TANAPA (Tanzania National Parks Authority) receives no direct government funding, it is able to obtain sufficient funds from park entry (tourism) revenues, supplemented by external donors (Robinson 2008).⁶ The use of hunting revenues to protect resources is not unique to developing countries. In the United States today, “various licenses, fees, and taxes on hunting and hunting equipment fund more than 90 percent of the budgets of state fish and wildlife agencies” (Burnett 2001, 2). Relying on these sources of revenue is much trickier in regions, such as West Africa, where there are few charismatic species.

⁵ Cost recovery is an increasing reality in many areas in developing countries because government agencies are more and more required to function as revenue-seeking parastatals, rather than relying on externally determined and granted budgets (Nolan and Turbat 1995; Robinson 2008).

⁶ The viability of trophy hunting as a revenue source is also influenced by international conventions, such as CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) and individual country laws, such as the U.S. Endangered Species Act that has recently been relaxed to permit the import of endangered species (Mbaria and Kelley 2005).

In the literature, fines are almost always considered a no-cost transfer from the individual acting illegally to the enforcement agency. Where cost recovery is a reality, fines play another critical role—providing a source of funding for enforcement. Yet, when a department relies on revenue from fines for some of its enforcement budget, the more successfully it deters illegal extraction and hunting, the smaller its budget becomes. What might be termed “perfect enforcement,” where no offences occur, will result in no income generation through fines. As a result, departments must find alternative funding sources for their budgets, whether from external options or legalization and sale of permits for less harmful, though previously illegal, activities (Robinson 2008). New international market mechanisms, such as payments for environmental services (PES) and the clean development mechanism (CDM), potentially can allow governments and local communities to share in the benefits of protected areas that accrue to those who do not bear the costs, including the international community (IAASTD 2008). However, until such programs are widespread and reach less unique forests, the relationship between budgets and revenue from fines will continue to be a prominent concern for forest managers.

2.3 Multiple Layers of Enforcement, Fairness, and Conflict

Most of the economics enforcement literature assumes that one agency or actor, typically a private or government agency, is the sole optimizer in determining levels of enforcement. The literature rarely incorporates the layers of jurisdiction or the varying incentives facing individuals in the implementation of an optimal plan. Key exceptions in the literature include Mookerjee and Png (1995), who described two layers of enforcement: the individuals who detect the illegal activities and those who set the rules and monitor those involved in detection. Some game-theory and village-institution literatures go beyond this single optimizer perspective in discussions of how a group agrees to establish rules.

In practice, multiple layers of enforcement are the rule rather than the exception. For example, in the Similipal Biosphere Reserve (SBR) in Orissa—as elsewhere—enforcement comprises multiple tiers of agents with potentially differing incentives. Low-paid forest guards, who might be termed the first tier, patrol large areas on foot or bicycle with few resources and little supervision. In another tier, foresters supervise the forest guards (one forester is typically responsible for 8–10 patrol officer beats) and also carry out enforcement activities. Above the foresters are the rangers, and above them, the forest managers—who typically are assumed to be the sole optimizer in theoretical models. It is unlikely that individuals at each level of authority have the same motivations and the same capacity to influence enforcement outcomes.

Because forest guards are at the front line of enforcement, they have most influence over how much and what type of enforcement actually happens. They can choose whom to punish and whom to let off, how much effort to put into enforcement, and whether or not to take a bribe. These decisions typically are invisible to the other levels of authority. Guards' decisions about whom to punish, either formally or informally, and from whom to take bribes is often biased. For example, in Orissa, the idea that some illegal actions are "more illegal" than others is very much ingrained in the decisions of foresters and guards, many of whom are also locals (authors' observations). Because the guards are generally sympathetic to the reality that new laws governing protected areas deprive villagers of their traditional access to forest products, they often ignore illicit extraction by locals for home use from forest reserves and even national parks. But, if guards choose which person to punish—perhaps influenced by the relative wealth of the perpetrator or by the alternatives available to the individual—they can cause resentment among groups in the community that feel that they are more likely to be punished. Despite this potential problem, guards who are—albeit informally—making decisions about what is an acceptable or "fair" level of extraction and what is a "fair" punishment may bring the enforcement regime closer to a social optimal that takes account of both resources and livelihoods.

Issues of fairness are particularly relevant in the poor country setting, given that the illegal extraction of resources is often undertaken by poor villagers who may have traditionally (albeit illegally) relied on resources from a particular protected area as vital contributions to their livelihoods. Concepts of fairness may depend on how many villagers appear to be "getting away" with the illegal activity, whether the resource is collected for home consumption or to sell, and whether the individual caught is local. Our interviews in Tanzania, China, and India, plus one author's experiences as a forester, all reflected the tendency of guards to make different enforcement decisions based on their concepts of fairness, especially with respect to extraction for subsistence home use.

The optimal enforcement literature almost always assumes that there is a fixed relationship between the amount spent on enforcement and the effectiveness of that enforcement. (Key exceptions include Mookerjee and Png [1995].) But, in reality, those actually responsible for enforcement—in Orissa, these are the forest guards; for PFM in Tanzania, it is the Village Environmental Committee—choose how much effort to put into enforcement. If rewards are not linked to performance and monitoring is lax, forest guards have little formal incentive to expend any effort. In fact, guards' incentives may center on the time it takes to process violators, personal financial gain from bribes, and the issues of conflict and retribution within their villages.

Unsupervised guards face some flexibility in determining how they record and book a particular offence. For example in India, when an individual is apprehended for killing a rare species or with valuable timber, guards often take the easier option of booking the offence as a “compoundable” case of firewood—where the individual caught pays a fine commensurate with taking a head load of firewood—because this lesser offence requires far less paperwork. If the true offence is booked, the forester or forest guard must make a case record, transfer the illegal resource to a storage place, guard it until it is disposed of, and may be required to appear in court.

Booking the lesser offence reduces deterrence for more serious crimes, but it does allow the guards to more spend time patrolling. By booking a lesser offense rather than no offense at all, the guards are also signaling to the forest managers that they are doing their job of patrolling, detecting, and then punishing illegal activity. In general, in Orissa, a compoundable case (in which the offender is released after the illegally taken goods are confiscated/compounded) takes between one and two hours for the forest guard to process; a prosecution case (the offenders and goods are brought to the rangers’ office, the goods are seized, the offenders’ case records prepared, and individuals released under self guarantee) takes between 3 and 7 hours; a case of arrest (typically offenders are prosecuted and then taken to court) takes between 10 and 24 hours of the guard’s time. Most of the time tends to be spent processing wildlife products—if a carcass is seized, there is an elaborate process that includes performing a post mortem of the animal, getting a death certificate from a local veterinarian, and burning the carcass in front of a witness—which takes a minimum of 8 hours. Another reason foresters and forest guards may not be inclined to book more serious offences is the low rate of conviction that reduces the deterrence effect of the forest laws and reduces further the incentives for foresters to incur the extra cost of processing a “prosecution” case.

Forest guards can also choose to take a bribe rather than make a formal charge, as we have seen in Orissa and suspect occurs elsewhere. Bribes do provide some regulation of resource extraction, and, indeed, they create an incentive for the guards to put more effort into apprehending individuals (Mookerjee and Png 1994). But with such informal regulation, much needed funds do not reach the authority responsible for protecting the resource and little data can be collated concerning the number of illegal acts that are detected and punished.

Guards themselves often incur non-budget costs, such as social recrimination in their villages and threats of bodily harm. Conflicts between villagers who harvest or hunt illegally and the managers of nearby protected areas are well documented throughout the world. Yet, the costs of conflict are rarely accounted for in the optimal enforcement literature. Punishing villagers for

extracting resources from forests and parks, particularly those who traditionally have had access, can cause bad will between rangers and villagers.

This situation is especially problematic if the ranger lives in the same village as those who poach flora or fauna. Indeed, the introduction of community-based management implies that often individuals from the same community both protect forest resources from fellow community and want to use a protected resource, potentially resulting in conflict. Such conflict can influence the immediate and the long-term protection of resources through its impact on social capital and cohesion within the village, in addition to the time spent managing conflict situations. This conflict makes the forest guard's job dangerous. Although unusual, it is not unheard of for rangers to be attacked or even killed by people extracting or hunting illegally (see table 1). Including the costs of conflict suggests that an optimal enforcement strategy should put increased emphasis on deterrence rather than punishment and possibly legalize less harmful activities.

Table 1. Incidence of Assault on Forest Guards in Orissa State, India

Year	No. of cases	No. of personnel involved	No. of personnel assaulted	No. of personnel injured/seriously injured	No. of personnel killed
1994–95	31	38	27	19	2
1995–96	45	48	31	17	0
1996–97	52	56	54	1	1
1997–98	57	66	49	15	2
1998–99	43	46	31	15	
1999–2000	30	57	45	9	3

Source: State of Orissa, "Orissa Forest Status Report, 2003-04," photocopy (Bhubaneswar, Orissa, India: State of Orissa, Department of Forest and Environment [Aranya Bhawan], 2004).

With the variety of incentives facing guards, it is difficult for a researcher to get reliable data on the extent of illegal activity in and around a particular protected area—even for the author who is a forest manager. In Orissa, we hired individuals from the forestry department to work with the foresters and forest guards and record the number of arrests and concomitant illegal activity, in addition to the location of the offence and socio-economic data on the

offender. But, even the records that we accumulated almost certainly are biased by the decisions of the foresters and forest guards to book most offences as fuelwood (table 2).

Table 2. Number of Recorded Offences and Typical Punishments over a Three-Month Period in Similipal Biosphere Reserve

Controlled resource	Number of offences	Typical quantity confiscated	Typical fine
Fuelwood	52	20–30 kg (1 head load)	INR 100–200
Poles	10	2–12 poles	INR 100–550
Timber	8	150–350 cubic feet	INR 300–1000 (only 1 arrest)
Forest bird	1	1 bird	Arrested and sent to court
Grazing livestock	1	N/A	Fined for “possessing fuelwood”

Note: INR = Indian rupee; 2006 conversion rate: INR 46 = US\$ 1.
Source: Authors’ survey, 2006.

3. Conclusion

Even with a trend toward less adversarial resource management approaches (such as participatory forestry, CBFM, and JFM), enforcement remains the central tool for controlling resource extraction from forest parks and reserves in developing countries. This enforcement faces a reality of under-funded enforcement agencies, underpaid staff with different incentives from those who set the rules, and institutions that rarely function efficiently. Protection efforts are further complicated by poverty and resource dependence, low penalties, relatively high costs of enforcement, and conflict between managers’ job requirements and rural people’s needs. Not surprisingly, in many developing countries, current protected-area enforcement practices do not work—protected areas in practice are often anything but protected. Moreover, optimal enforcement models and recommendations currently found in the law and economics literature only have partial relevance for resource managers in developing countries.

Our research identified a number of areas where there is need to reduce the gaps between theory and practice. First, the literature’s emphasis on a sole optimizer misses the sometimes conflicting incentives facing multiple tiers of enforcement agents. Once multiple tiers are recognized, a framework that addresses the problems of guards’ motives and efforts, bribery,

equity, and conflict becomes clearer. Second, the literature's failure to address the source of enforcement budgets and its focus on social-welfare optimization marginalize several key practical elements of enforcement, including the (small) size of enforcement budgets, budget reliance on cost recovery from fines, and how to deal with low fines relative to social value. Third, a growing literature addresses the temporal aspects of optimal enforcement, including repeat offenders, but little in the literature addresses the spatial aspects of enforcement. Spatially differentiated enforcement, such as introducing a sufficiently large buffer zone into a protected area, would acknowledge that not all environmentally harmful activity can be prevented. In addition, spatial enforcement would permit less harmful activities in some regions, such as extraction near a village, to reduce conflict and better control areas of extraction. Fourth, guards react to complex incentives in ways that may further distort the relationship between the crime and the punishment. More research and data are needed to address the interactions between poachers and guards. Without increased research in these and other areas, the current literature will remain insufficient to inform pressing practical resource-management policies in developing countries.

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