Comparing the effectiveness of forest law enforcement and economic incentives to prevent illegal logging in Bangladesh

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SUMMARY

Enforcement of the law is the most widely practiced strategy to prevent illegal logging in tropical developing countries, though the efficacy of such practice has often been questioned. We examined the effectiveness of forest law enforcement and different forms of economic incentives to curb the activities of illegal loggers. Thirty households, both with and without economic incentives, were interviewed in 2007 and 2009 in two protected areas of Bangladesh, namely the Lawachara National Park and the Satchari National Park. The enforcement of customary forest law appears to have very little ability to tackle illegal logging, whereas different alternative income-generating options designed to influence the livelihoods of illegal loggers are revealed to be very useful because such initiatives were found to have considerably reduced both the number of illegal loggers and the frequencies and amount of timber harvested illegally in both sites. Interestingly, illegal loggers responded most positively when they found themselves much closer to forests with clearly defined rights and responsibilities. Securing development of local forest users with tenure rights and greater access to alternative income-generating options, market regulation, and institutional and regulatory reform are critical to control illegal logging and to guarantee the sustainability of declining forest resources.

Keywords**:** law enforcement, co-management, alternative income generation, conservation, Bangladesh

Comparaison de l'efficacité des efforts pour faire respecter le loi forestière et des offres de bénéfices économiques pour empêcher la coupe de bois illégale au Bengladesh

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Les efforts pour faire respecter la loi sont la stratégie la plus répandue pour empêcher la coupe de bois illégale dans les pays tropicaux et en voie de développement, bien que l'efficacité de cette approche ait souvent été mise en question. Nous avons examiné l'efficacité des efforts pour faire respecter la loi et différents formes d'offres économiques pour parer aux activités des coupeurs de bois illégaux. Trente foyers, bénéficiaires ou non d'offres économiques, ont été interviewés en 2007 et en 2009 dans deux zones protégées du Bengladesh: le parc national du Lawachara et le parc national du Satchari. Le respect forcé des lois de forêts en application semble être très peu capable de parer à la coupe de bois illégale, alors que des options génératrices de revenus alternatifs visant à faire un différence dans la vie des coupeurs illégaux se sont révélées être très utiles, ayant réussi à réduire considérablement le nombre des coupeurs de bois illégaux et la fréquence et la quantité de bois récolté illégalement dans les deux sites. Il est intéréssant de noter que ces travailleurs illégaux répondaient le plus positivement quand ils se retrouvaient proches des forêts dans lesquelles les droits et les responsabilités étaient le plus clairement définis. Assurer le développement des utilisateurs locaux de la forêt à l'aide de droits d'usage et d'un accès plus ouvert à des options génératrices de revenus alternatives, la régulation du marché et des réformes instirutionnelles et régulatoires sont critiques pour contrôler la coupe de bois illégale et garantir la durabilité des ressources forestières déclinantes.

Comparación de la eficacia de la aplicación de la legislación forestal y los incentivos económicos para evitar la tala ilegal en Bangladesh

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La aplicación de la ley es la estrategia que más se practica para evitar la tala ilegal en los países tropicales en desarrollo, aunque a menudo se ha cuestionado la eficacia de esta práctica. Se examinó la efectividad de la aplicación de la legislación forestal y de las distintas modalidades

de incentivos económicos con las que frenar las actividades de los madereros ilegales. Se entrevistaron treinta hogares, que recibían o no recibían incentivos económicos, durante 2007 y 2009 en dos áreas protegidas de Bangladesh, a saber, el Parque Nacional Lawachara y el Parque Nacional Satchari. La aplicación de la legislación forestal consuetudinaria pareció tener muy poca capacidad para frenar la tala ilegal, mientras que las diferentes alternativas de generación de ingresos diseñadas para influir en los medios de vida de los madereros ilegales mostraron ser muy útiles, ya que tales iniciativas redujeron considerablemente tanto el número de madereros ilegales como la frecuencia y el volumen de madera aprovechada ilegalmente en ambos sitios. Curiosamente, los madereros ilegales respondieron más positivamente cuando se encontraban mucho más cerca de bosques con derechos y responsabilidades claramente definidas. El asegurar el desarrollo de los usuarios locales de los bosques mediante derechos de tenencia y un mayor acceso a alternativas para la generación de ingresos, la regulación del mercado y la reforma institucional y normativa son fundamentales para el control de la tala ilegal y garantizar la sostenibilidad de unos recursos forestales cada vez más escasos.

INTRODUCTION

Illegal logging[1] is one of the major threats to forests in tropical developing countries, which have long been subjected to rapid deforestation and degradation driven largely by poverty and complex socio-political settings (Contreras-Hermosilla 2002, Kaimowitz 2003, Tacconi *et al*. 2003). Globally, illegal logging is worth more than US$10 billion every year, and costs developing countries US$5 billion in lost revenues per annum (World Bank 2006). In addition, illegal logging undercuts the prices of legally produced forest products by an estimated 7–16 % (AFPA 2004). In Indonesia, for example, illegal logging continues at a rate of at least 40 million cubic meters annually, exceeding the country's official timber production and jeopardizing the sustainability of the last remaining rainforests of South East Asia (Obidzinski *et al*. 2006). According to the Food and Agriculture Organisation of the United Nations (FAO), half of the world's illegal timber harvested is destined for domestic consumers (DFID 2007). In recent decades, international concerns about illegal logging have grown markedly, and many forest certification schemes recognized by the Program for Endorsement of Forest Certification Schemes (PEFC) have emerged chiefly as a consequence of this. There has also been a growing concern about the legality of timber amongst importing developed countries e.g. the European Union's Action Plan on Forest Law Enforcement, Governance and Trade. In the EU's action plan, there have been moves to develop a voluntary partnership with tropical timber-producing and exporting countries along with introduction of a licensing system to provide safe passage to legally harvested timber (EU 2003).

The underlying factors contributing to illegal logging, and its impacts on livelihoods, biodiversity, and national economies, have been poorly investigated, although there is plenty of speculation and action is being taken to tackle this problem without a basis in evidence (Tacconi *et al*. 2003). In many tropical countries, low compliance with existing forest laws rather than a lack of law is often a leading cause of illegal forest practices (Contreras-Hermosilla 2001, Hirakuri 2003). Poor compliance raises a series of questions about the enforcement of forest laws. Forest law enforcement has broadly been considered as the first necessary step in combating illegal logging but, among all those involved, poor rural dwellers are amongst the first and hardest hit by more vigorous applications of existing laws (DFID 2007, Inoguchi *et al*. 2005). Notwithstanding this, in the long run, illegal logging might lead to the collapse of a country's forest industries, with an attendant reduction in government revenues, loss of social capital, and loss of ecosystem services and benefits provided by forests (Kaimowitz 2003). However, Tacconi (2007) has controversially argued that illegal logging (seemingly paradoxically) provide more benefits to diverse forest stakeholders in these countries, particularly local forest-reliant communities who engage in illegal logging for their livelihood needs.

Community involvement is considered to be critical in effective forest management and in controlling illegal logging in the tropics. People living in or adjacent to forests here have greater stakes in forests than people in any other regions, they are both responsible for deforestation and forest degradation and are also the most vulnerable to their consequences (DeFries *et al*. 2010, Mukul and Quazi 2009). Governments and international donors, in recent years, have accordingly placed stronger emphasis on greater community involvement in forest management to tackle illegal logging through various support mechanisms (Inoguchi *et al*. 2005). Providing economic incentives to local forest dependent communities through development of alternative income-generating (AIG) are amongst the most common support mechanism in this aspect.

This paper is based on a case study in which we investigated the effectiveness of economic incentives to illegal loggers and enforcement of forest law to control illegal logging. To do this, we used a case-study approach and interviewed 30 illegal loggers in 2007 and 2009, both with and without economic incentives using a semi-structured questionnaire. The remaining sections of the paper are organized as following. We first describe the basis of forest management in Bangladesh and then describe the study area along with the methods we used to collect the data. The results section has been followed by discussion. Finally, we attended up some recommendations and policy options based on both respondents' survey and interviewees with other stakeholders

[1] In this study, illegal logging is taken to mean any felling and extracting of logs from forests that is not in conformity with an approved management plan, or is not officially licensed or permitted in any other way by a forest authority in accordance with operations that are permitted under prevailing forest laws, as defined in Mir and Fraser (2003).

to better tackle the situation and to ensure a sustained future of the forests in this region. We believe, our study, with little uncertainty, can be used to comprehend such situations in other South Asian countries, particularly India and Nepal, where regulation of customary forest use has historically been amplified in forest management systems, with large numbers of people being dependent on the forests for sustaining their livelihoods.

FOREST MANAGEMENT IN BANGLADESH

Forest management in Bangladesh commenced in 1864, and for nearly one hundred years the British colonial system shaped Bangladesh's forest management, as was the case in India and Pakistan (Alam 2009, Khan 2001, Poffenberger 2000). The forest management system in Bangladesh has historically been based upon sustained wood production emphasizing mostly silvicultural aspects, with minimal attention to forest-people interactions and local involvement in formal forest management (Biswas and Chowdhury 2007). Bangladesh has one of the highest deforestation rates in South and South-East Asia, with deforestation currently taking place at an annual rate of 2%, and with forest coverage now being as little as 10.2% (FAO 2009, Lawrence 2007). Since poverty and unemployment are widespread, particularly in the rural fringes adjacent to forests, illegal forest activities and illegal logging are quite common, and irrefutably pose major challenges to the sustainability of forest resources and their management in Bangladesh (Mukul *et al*. 2010, 2012).

Enforcing forest law is the most pervasive method used to control illegal logging in the country, pursuant to the *Forest Act 1927* that was formulated during the British colonial era, with subsequent amendments by the government being made in 1994 and 2000 (Alam 2009, Millat-e-Mustafa 2002). Under this act, illegal logging is treated as a forest offence, and is punishable by imprisonment for a term of between six months and five years, with additional fines that may range between Tk2,000[2] and Tk50,000, and with the directing court having the power to order offenders to pay compensation for any damage done to the forest. As is the experience in many other tropical countries, this law does not seem to have been effective in controlling illegal logging in Bangladesh, and, in many cases, it has caused conflicts with local forest user groups. In fact, illegal logging in Bangladesh is somewhat emblematic of such activity in South-East Asian countries (e.g. Indonesia, Malaysia, and the Philippines), despite there being larger forest coverage in those countries, with more mechanized illegal logging taking place mainly to supply the global timber market. Here, by contrast, small-scale logging is pervasive and deploys manually operated hand-saws, and timber is traded in the domestic market only.

Engaging local communities in forest management is a recent practice in Bangladesh, initiated in some protected areas (PAs) with the dual purpose of limiting forest degradation and enhancing the wellbeing of local communities (Chowdhury *et al*. 2013, 2014; Mukul *et al*. 2012, Rashid *et al*. 2013). The Forest Department (FD) developed the Nishorgo Support Project (NSP), a forest co-management program, in five PAs with active support from the United States Agency for International Development (USAID). The project ran until 2007, and was then relaunched and extended in 2009 under the Integrated Protected Area Co-management (IPAC) program. During the project implementation period, a variety of initiatives were undertaken to increase local communities' active involvement in forest management and conservation in pilot PA sites. Core initiatives include economic incentives through development of AIG options such as nursery raising, fisheries, and livestock and poultry rearing, and involving local people in forest patrolling and as eco-tour guides, etc. These efforts, however, were inadequate and were mainly targeted at the most forest-reliant segment of the community, for example the local illegal loggers, in order to divert them from harmful forest activities and to provide them with some basis for their livelihoods.

MATERIAL AND METHODS

Background of the study sites

The study was conducted in two national parks of Bangladesh: Lawachara National Park (LNP) and Satchari National Park (SNP) (Figure 1). Both PAs were located in the north-eastern part of the country and were selected purposively for the study since they are amongst the five pilot sites in which the FD initially started its co-management program (Rashid *et al*. 2013). LNP was established on 1996 while SNP was declared as a PA quite recently on 2005. Both PA offers a unique example of park-people interactions at different scale because of their size and there are several indigenous communities including *Khasias*[3] and *Tripuras*[4], living within the forests in both sites.

Administratively, both PAs are under the jurisdiction of the FD. The LNP forms part of the greater West Bhanugach Reserve Forest, and the SNP comprises part of the greater Raghunandan Hills Reserve Forest within the Satchari Range. Table 1 provides brief profiles of the study sites. Being situated along the Indo-Burma Biodiversity Hotspot, both PAs are characterized by rich floral and faunal diversity (Mukul 2008). They are amongst the largest and last strongholds of critically endangered Hoolock Gibbons (*Hoolock hoolock*) – one of the last apes in the Indian sub-continent, and Hooded

[2] Taka or Tk is the Bangladeshi currency, and the current exchange rate is Tk72 ~ US$1.

[3] The *Khasia* are the Mongolite ethnic group, who descended to the Khasia hills and Jainta hills from the neighboring Cherapunji and Shilong regions of India. They are one of the matriarchal tribes in Bangladesh.

[4] The *Tripuras*, also called the Tipra, are the third largest tribal group of Bangladesh (after the *Chakmas* and the *Marmas*), and were originally from the Tripura state of India.

FIGURE 1 *Map of the study sites*

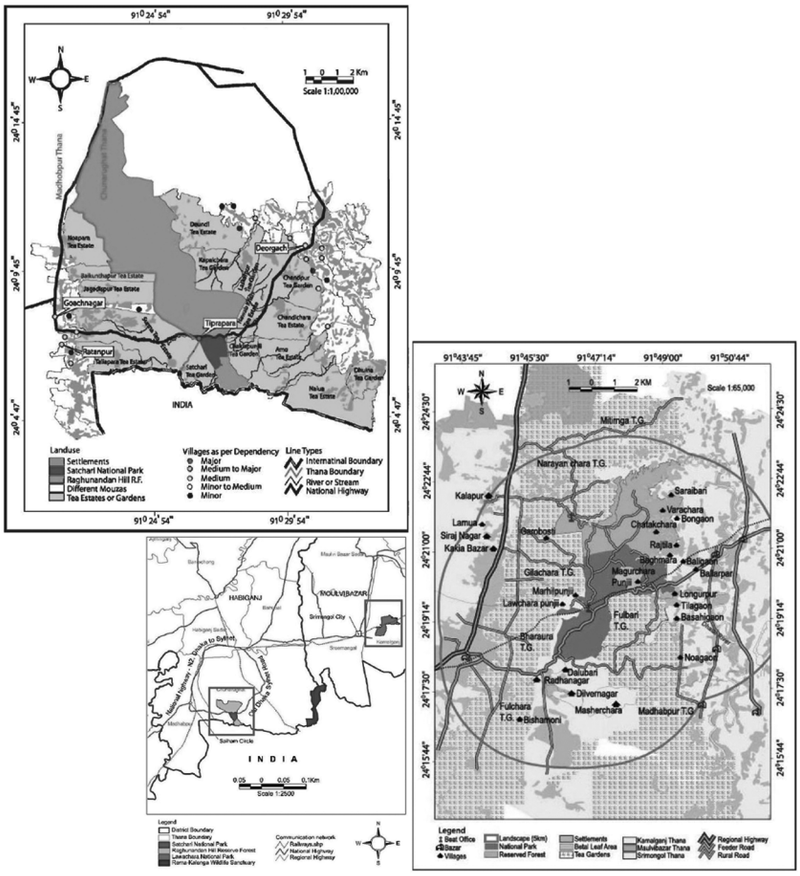


TABLE 1 *Profile of the study sites*

	Study site	
	LNP	**SNP**
Area	1, 250 hectares (ha)	243 ha
Geographic range	24⁰30/-24⁰32/ N and 91⁰37/-91⁰39/ E	24⁰5/ - 24⁰9/N and 91⁰24/- 91⁰29/E
Vegetation type	Tropical wet semi-evergreen forests;[1] mixed plantations of *Tectona grandis*, *Lagerstroemia* spp., *Artocarpus chaplasha* and *Dipterocarpus turbinatus*	Mixed tropical evergreen forest;[2] mixed plantations of *Acacia* spp., *Eucalyptus camaldulensis*, *Tectona grandis* and *Albizia falcataria*

[1]According to MacKinnon (1997), [2] according to Champion (1936).

Pitta (*Pitta sordida*) – a spectacular but rare bird species in the country (Muzaffar *et al*. 2007).

Both the LNP and the SNP are surrounded by a complex landscape, dominated by tea (*Camellia chinensis*) gardens, old growth plantations of commercially valuable timber species plantations established between 1920 to 1950, bamboo and rattan plantations, and agricultural mosaics (Halim *et al*. 2008, Uddin *et al*. 2013). There are also rubber (*Hevea brasiliensis*) plantations around the LNP and an experimental oil palm (*Elaeis guineensis*) plantation in the SNP. The topography of both PA is undulating with slopes and hillocks ranging from 10 to 50 meters in elevation. Numerous trails and tracks are common within both forests, created mainly by the local communities for collecting firewood and other forest produce. In the LNP, approximately 130 ha of forest area has been utilized for betel leaf (*Piper betle*) cultivation, primarily by the *Khasia* community, whilst in the SNP the indigenous *Tripura* community have cultivated lemon (*Citrus limon*) in a confined area within the park area.

Methodology

Baseline survey

The baseline survey for this study was conducted in early 2007. During the survey, key informants were selected for both study sites with the help of local FD officials. Thirty

illegal loggers[5] (*N*=30) were identified with the help of key informants and through community mapping in both sites. Amongst them, 16 were from the LNP and 14 were from the SNP. In order to make the necessary comparisons, we chose to study illegal loggers both with (n=18) and without (n=12) economic incentives in the form of access to AIG support mechanisms available under schemes pertaining to co-management of forests and protected areas operated by the FD in both sites. Not all AIG support mechanisms, however, were directed towards the male members of the family, some were targeted towards the female members too. Therefore, if any member (male or female) of a family received AIG support from the FD, the respondent corresponding to that family was considered as being provided with economic incentives. In several cases, there was more than one family member involved in illegal logging; in such situations, we selected only one respondent from that household to better represent the study area.

Data collection

Face-to-face interviews with illegal logger (N=30) were carried out in 2007 and 2009 in both study sites using a semi-structured questionnaire. Respondents were asked to recall the frequency of any illegal logging they had committed in corresponding years (i.e. 2007 and 2009). The average number of entry per month for illegal logging for the respective years and the average load bearing capacity of each corresponding respondent was recorded. Information about respondents' historic profiles of illegal logging (i.e. number of cases mounted by the FD, fines, or punishments they received, etc.), year involved, and motives for illegal logging was also collected. Additionally information regarding households' access to any economic incentives from the FD, basic demographic and socio-economic features of the family, their forest resource dependency pattern was recorded. Households' incomes were collected under two main categories, i.e. forest income and non-forest income, where forest income included the direct cash income from selling of forest products, subsistence income (i.e. savings) from consuming forest products which they may otherwise have to purchase from market and income derived from illegal logging. Non forest income included any other income other than the above three. In all cases local units and terms were used for the convenience of data collection. In order to obtain further insight into the socio-political dynamics and other factors that might influence illegal logging at the local level, informal and open-ended interviews were undertaken with local FD field staff members (i.e. the Assistant Conservator of Forest, beat officers, etc.) and politically influential persons who apparently had substantial influence on neighboring forests and the local environment (n=6). A rapid survey at the local timber market and nearest regional market in Sylhet city was also undertaken to record the prices of major timber species in both markets.

Ethical and other considerations

Disclosure of forest crimes committed by local communities is a sensitive issue, and questions may raise suspicion and involve risk (Downes and Rock 1995). Such a situation has partly been countered by a substantial degree of trust built by the researchers with the respondents with the help of local key informants, as well as through frequent interactions prior to the administering of the survey. We assured all respondents of the full confidentiality of their participation and all information collected was recorded anonymously, with each respondent being assigned a unique number. It is, however, quite likely that the frequency of illegal logging and possibly its severity has been underestimated here.

Data analysis

Descriptive statistics were used to analyze the quantitative data that were collected. To report any significant differences in the values a paired sample *t*-test of means was performed. To quantify the amount of timber harvested illegally by a person, we multiplied the frequency of logging activity with load-bearing capacity (in cubic feet, cft) of the corresponding person. Also, since all the economic incentives are broadly targeted to improve the situation of the family rather than the individual person, cumulative data regarding frequencies and amount of forest resource collection, both from the national parks and surrounding reserves, by all members of a respective family has been taken into consideration. We combine both quantitative and qualitative data whenever possible to better describe the scenario.

RESULTS

Background information of the respondents

The illegal loggers involved in the study had an average age of 37 years and a literacy rate of 20%. Both the family size and number of male and female family members were slightly higher in the LNP (Table 2). The majority (70%) of the illegal loggers were without any kind of permanent job. The number of years in which the respondents had been involved in illegal logging in both sites varied from between

TABLE 2 *Family size of the respondents in the LNP and the SNP (n = 30)*

Family members	Study site	
	LNP*	SNP
Male	3.50 (±1.21)	2.79 (±1.19)
Female	4.63 (±1.41)	3.93 (±1.21)
Total	8.13 (±1.93)	6.71 (±1.73)

*The values in parentheses denote the standard deviation (±SD) of the mean.

[5] Throughout this article we have used 'illegal loggers' and 'respondents' synonymously, and the term 'household' has been used to indicate collectively the corresponding families of the illegal loggers.

TABLE 3 *Distance and households' entry to forests for collecting timber and other forest products during 2007 and 2009*

Study site	Distance (km)	Number of entries/month*	
		2007	2009
LNP	1.0 (±0.86)	14.50 (±2.48)	12.38 (±2.70)
SNP	1.32 (±1.15)	13.36 (±2.71)	12.93 (±2.92)
Average	1.15 (±1.0)	13.97 (±2.61)	12.63 (±2.77)

*For the purpose of both timber extraction and for collecting NTFPs.

TABLE 4 *Households' income (in Tk. month^{-1}) from different sources during 2007 and 2009*

Source	LNP		SNP		Average	
	2007	2009	2007	2009	2007	2009
Selling forest products*	1825.00 (±547.11)	2118.75 (±502.29)	2114.29 (±436.52)	2521.43 (±610.40)	1960.00 (±511.66)	2306.67 (±582.46)
Consuming forest products**	2062.50 (±795.72)	2231.25 (±770.90)	2728.57 (±625.64)	2771.43 (±701.02)	2373.33 (±785.62)	2483.33 (±776.41)
Illegal logging	3687.50 (±1678.04)	2237.50 (±1915.85)	3657.14 (±1503.70)	1714.29 (±1138.73)	3673.33 (±1571.72)	1993.33 (±1596.97)
Others	731.25 (±633.21)	2075.00 (±976.05)	471.43 (±518.03)	2150.00 (±528.79)	610.00 (±587.43)	2110.00 (±787.12)
Total	8306.25	8662.5	8971.43	9157.15	8616.66	8893.33

* Includes both fuelwood and NTFPs but other than timber.
** Includes small logs for domestic use too.

2 and 11 years. Again, amongst the respondents, 17 persons had, received punishment according to the provisions of existing forest law, with 64% having received this on more than one occasion.

Forest dependency and income

The mean distance of the households from forests (i.e. national parks and surrounding reserves) was 1.15 km (Table 3). Several of the respondents, particularly those belonging to the indigenous *Khasia* and *Tripura* communities, lived inside (d=0 km) the forests with the consent of the FD. All the respondents were heavily dependent on forests and were found to harvest both timber (illegal logging) and non-timber forest products (NTFPs) for the purposes of both subsistence and income. The major NTFPs in the study sites were, in declining order of importance, fuelwood, bamboo, rattans, medicinal plants, and sands. In addition to these, in the LNP, betel leaf growing in the forest trees was one of the major products collected by the *Khasia* respondents. In the SNP, lemons were one of the major products collected by the *Tripura* communities. The numbers of entries made by the households into both study sites were 13.97 and 12.63 respectively during 2007 and 2009 (Table 3). The average monthly family expenditure of the respondents was about Tk[6]8,616 and Tk8,893 respectively during 2007 and 2009. These amounts included sales from the forest products they had sold in the markets as well as the value of all of the produce they had derived from forests that they might have otherwise purchased from the market. Table 4 provides details of the households' incomes from the forests and from other sources. Paired-samples t-test suggests that there were significant differences in the households income during 2007 and 2009 from selling forest products (t=4.60, p<0.05), consuming forest products (t=2.78, p<0.05), illegal logging (t=8.23, p<0.05) and from others (t=9.63, p<0.05). Illegal logging contributed to about 43% of the households' monthly expenditure in 2007, but dropped to about 22% during 2009 (Figure 2), presumably due to the existence of several alternative sources of income that were made available to the communities by the FD under the broad heading of economic incentives.

Economic incentives and households' engagements

The economic incentives and the provision offered (as different AIG schemes) are given in Table 5. Not all of these were targeted at male members of families, some were also aimed at women. Table 6 lists the distribution of AIG support mechanisms in the study sites.

[6] The exchange rate with the US$ was about Tk69.5 during the time of the study.

FIGURE 2 *Relative importance of forest and other incomes in 2007 and 2009*

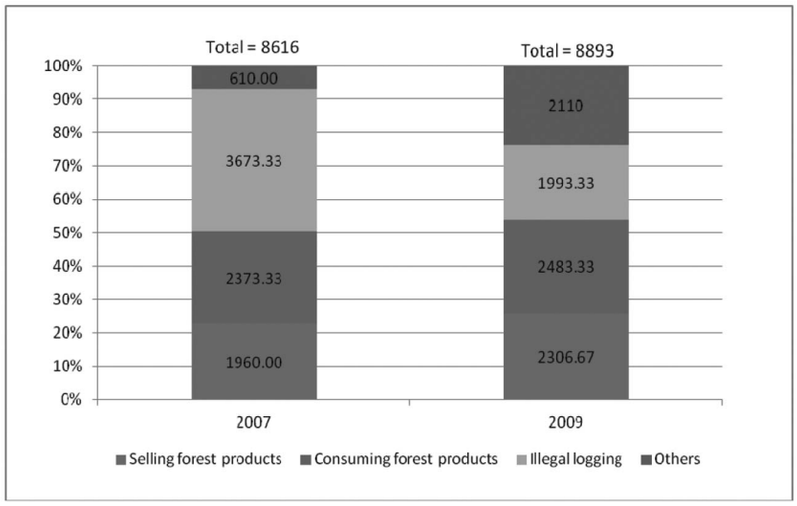


TABLE 5 *Economic incentives and form of support in the area*

Type of support	Form of support	Target group(s)
Eco-tour guide	Training and promotion to tourists	Men
Fisheries	Hatched fish	Men
Forest patrol guard	Uniform, monthly salary	Men
Livestock (beef, pig)	Cow, pig (for ethnic people)	Women
Nursery	Seeds, poly-bags, fertilizer, small amounts of money for fencing, support during selling	Men/women
Poultry rearing	Hatched chickens, small amounts of money for housing	Men/women
Vegetable gardening	Seeds, small amounts of money for fencing	Women
Rickshaw	Loan to purchase rickshaw	Men

TABLE 6 *Number of households with different forms of AIG support in the LNP and the SNP*

AIG support	Study site		Total
	LNP	SNP	
Eco-tour guide	-	1	1 (5.56)
Fishery	-	1	1 (5.56)
Forest patrol guard	5	2	7 (38.89)
Livestock (beef, pig)*	2	1	3 (16.67)
Nursery	-	1	1 (5.56)
Poultry rearing*	2	-	2 (11.11)
Vegetable gardening *	1	2	3 (16.67)
Total	10	8	18

Source: Field survey (2007–09), the values in parentheses indicate the percentage (%) of the total population.
*Received by female members of the family only.

Economic incentives, in most cases, took the form of technical or skill development support (e.g. training), or the form of provision to former illegal loggers of startup materials for intended development instead of the direct provision of cash. In a limited number of cases, small amounts of seed money were also given and respondents were monitored closely to ensure appropriate use of the investment. The level of support and resulting benefits varied between the different AIG schemes. The support schemes seemed also varied in terms of how closely they involved the forest i.e. forest patrol guards

and eco-tour guides involved close connection with the forest while the remaining schemes had little or no connection to the forest.

Effect of economic incentives in preventing illegal logging

A quantitative analysis of frequency of illegal logging, and quantity of timber collected (in cubic feet, cft) amongst the respondents with and without economic incentives during 2007 and 2009 is given in Table 7. Paired *t*-test revealed that there were significant differences in the number of entries (t=4.10, $p<0.05$) and quantity of timber collected (t=4.05, $p<0.05$) during 2007 and 2009. Illegal loggers who received AIG support reported substantial reductions in the frequency of their illegal logging activities (t=5.62, $p<0.05$) and a corresponding reduction in the quantity of timber collected (t=6.38, $p<0.05$). It was the case that some of the respondents with economic incentives were found to be involved in illegal logging even with FD support, but the number of times they entered the forests for illegal logging and the quantity of timber they collected were reduced as compared to the situation before their involvement in various support initiatives. The illegal loggers who received support as eco-tour guides, for nursery activities or for fisheries activities stopped illegal logging, possibly because these provisions were able to generate income on a regular and sustainable basis. In contrast, economic incentives for poultry rearing and vegetable gardening appeared to have less influence on illegal logging since the financial outcomes of these activities were much more uncertain and because the benefits accrued more slowly than they did for other types of support initiatives. Illegal loggers without any kind of support were more active in illegal logging than previously.

Other factors influencing illegal logging

During the respondents survey when asked the reason why engaged in illegal logging several issues were mentioned by the illegal loggers that promoted their illegal forest activity (Table 8). Poverty and lack of a permanent job were cited as the major reasons for illegal logging (70%) in the area. Other than that, exclusion from available AIG support schemes (33.33%) and inadequate off-farm activities (40%) were also said to be influencing illegal logging. Seasonal flash floods are common in both sites, and 23.33% of the respondents mentioned that there was a crisis time following a flood and also spread of diseases and that these were reasons for their illegal logging. Others issues were a lack of recognition of

FIGURE 3 *(Clockwise, faces are intentionally made unidentifiable here): (a) The stump of an old Teak tree after being subjected to illegal logging, (b) Transportation of logs through a surrounding tea garden, (c) Logs brought through the forest trail, (d) Processing of low-value logs in the forest to facilitate transportation (Photo credits: S.A. Mukul)*

ONLINE COLOUR ONLY

TABLE 7 *Frequency of illegal logging (monthly) among illegal loggers with and without AIG support in the LNP and the SNP*

Type of support	2007 (pre-support period)			2009 (project support period)		
	Persons involved	No. of entries*	Quantity (cft)**	Persons involved	No. of entries*	Quantity (cft)**
Eco-tour guide	1	16	80	0	-	-
Fishery	1	8	96	0	-	-
Forest patrol guard	7	11.14 (±3.98)	106.85 (±46.35)	1	0.285 (±0.76)	2.3 (±6.05)
Livestock (beef, pig)	3	8.33 (±0.58)	96 (±42.33)	1	0.67 (±1.15)	10.67 (±18.48)
Nursery	1	8	96	0	-	-
Poultry rearing	2	12 (0)	144 (±33.94)	2	2 (0)	24 (±5.65)
Vegetable gardening	3	9.33 (±2.3)	90.66 (±9.24)	2	7.33 (±6.43)	80 (±69.28)
Without any support	12	11.5 (±3.18)	136.5 (±27.8)	12	12.7 (±2.15)	158.7 (±50.1)
Total	30	325	3506	18	172	2125

Source: Field survey (2007–09), the values in parentheses indicate the standard deviation of the mean (±SD).
* Approximated monthly entries for illegal logging from the nearby forest.
**Averaged volume in cubic feet, after balancing individuals' log holding capacity and number of entries per month.

TABLE 8 *Motives for illegal logging as cited by the respondents*

Reason for engaging in illegal logging	Study site		Total
	LNP	SNP	
Poverty	9 (56.25)	12 (85.72)	21 (70.0)
Unemployment	11 (68.75)	10 (71.43)	21 (70.0)
Inadequate off-farm activities	6 (37.5)	6 (42.86)	12 (40.0)
Exclusion from support	4 (25.0)	6 (42.86)	10 (33.33)
Crisis	3 (18.75)	4 (28.57)	7 (23.33)
Others	2 (12.5)	3 (21.43)	5 (16.67)

Source: Field survey (2007), Values expressed in parentheses represent the percentage (%) of the total population.

traditional usufructs and limited knowledge about the existing forest law and rules.

During interviewees with other stakeholders' poverty and limited AIG supports were stated as the main reasons that boost illegal forest activity in the area. It was reported by the interviewee that a 2.5 ft trunk of any good quality timber is worth around Tk500-700, and this sum could secure the livelihood of a family of about four members for at least a week in the area. Illegal timber is also cheaper compared to the corresponding prices in the nearest regional market (Table 9).

DISCUSSION

Economic incentives provided in the form of AIG support were very effective in reducing illegal logging in the LNP and SNP. The most important observation of this study is that even though support was still very limited and in many cases inadequate, economic incentives in the form of AIG support were found to potentially contribute to preventing and/or reducing illegal logging. While law enforcement often appears to be the simplest way to control most illegal forest activities, including logging, there is evidence that stricter law enforcement can worsen the situation and hurts local forest inhabitants (Cerutti and Tacconi 2008, van der Ploeg *et al*. 2011). In fact, it has been found that increased legitimacy and empowerment significantly influence rural forest users' willingness to cooperate in conservation efforts (Paloniemi and Vainio 2011). We also found, however, that the efficiency of different types of economic incentives varied in the areas studied, with illegal loggers responding more positively to those schemes that provided them with clearer rights associated with and responsibilities towards the forests upon which they depended. For example, illegal loggers who have been recruited as forest patrol guards reacted more optimistically than illegal loggers whose other family members received different types of support (e.g. poultry, livestock rearing). Such an observation is also made by a study by Mackenzie *et al*. (2011) in respect of a national park in Uganda, in which he found that local community associations approved of legitimate forest management operations only when they benefited from such activities.

Again, in tropical developing regions, forest law has been enforced in a manner that is sometimes discriminatory and

TABLE 9 *Price variation of major timber species at local and urban markets*

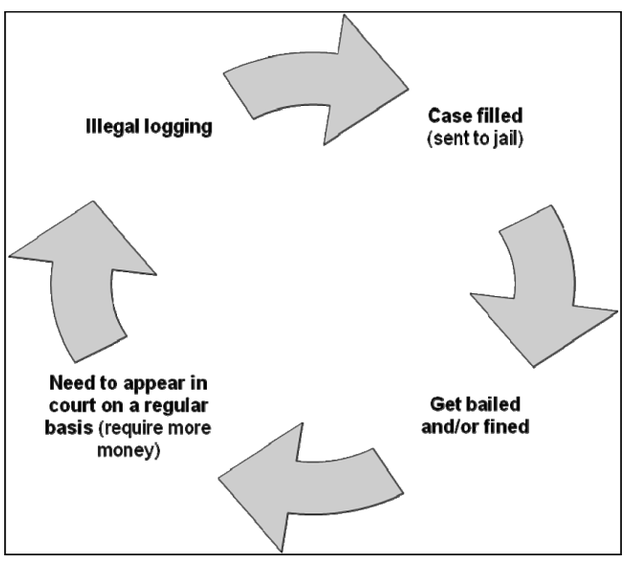
Local name	Scientific name	Price (Tk cft^{-1})		
		Local market	Urban market*	Difference
Acacia	*Acacia auriculiformis*	400–500	750–1000	350–600
Mangium	*Acacia mangium*	350–400	700–800	350–450
Koroi	*Albizzia procera*	300–350	900–1200	600–900
Raintree	*Albizzia saman*	300–350	500–800	200–500
Chapalish	*Artocarpus chaplasha*	250–300	600–900	350–650
Kanthal	*Artocarpus heterophyllus*	450–600	650–800	200–350
Gamar	*Gmelina arborea*	400–450	750–1000	350–600
Mahagoni	*Swietenia* sp.	400–450	900–1200	500–800
Jam	*Syzygium* sp.	500–600	900–1200	400–700
Teak	*Tectona grandis*	700–900	1500–1800	800–1100

Source: Field survey (2007).
*Based on the price at the nearest regional market in Sylhet city.

abusive, targeting the poorest and most marginal portions of society (Chhetri *et al*. 2012, Kaimowitz 2003, Tacconi 2007). In our study, the use of forest law worsens the situation in most circumstances because it does not recognize the livelihoods of poor illegal loggers who have no other means to earn money to support their families other than illegal logging. Very disappointingly, in many cases, enforcement of the law in the areas actually creates a vicious cycle of illegal logging (Figure 4), in which the illegal loggers continue and increase the level of their illegal activities to enable them to afford the fees associated with their legal representation and appearances in court in addition to enabling them to sustain their livelihoods as usual.

Undeniably, enforcing stricter protection status and regulating human use of forests can positively influence forest conservation (Uddin *et al*. 2013). However, this is not practically possible in the tropics, in which the causes of illegal logging can be manifold. Limited AIG supports in addition cause exclusion of many local community people in forest management, which they deem to be denying their traditional rights which often generates conflicts and potentially leads to unsustainable use of forests by some villagers (Mukul *et al*. 2012). In general, factors driving illegal logging include the needs of the poor, the greed of other people, and weaknesses in forest governance (Tacconi *et al*. 2003). Weak institutions and limited governmental resources in developing countries also limit governments' capacity to control illegal logging (World Bank 2006). In human-dominated landscapes, instead of enforcing legislation, sustainable use and incentive-driven conservation should both be at the centre of the conservation agenda (Hutton and Leader-Williams 2003). In fact, both economic incentives and social norms work together to influence stakeholders' motivations for engaging in deforestation by sacrificing short-term gains (Satake 2007).

FIGURE 4 *The vicious cycle of illegal logging*



The widespread violation of existing forest laws and regulations indisputably has had negative impacts on forests (Kaimowitz 2003), and this negative impact has further been exacerbated by historical budgetary allocations that have seen inadequate staffing for local institutions responsible for law-enforcement activities (Jachmann 2008). Corruption and misuse of power and influence are also two of the major reasons for deforestation in areas of the developing tropics (Geist and Lambin 2002).

CONCLUSION AND RECOMMENDATION

The study clearly demonstrates that economic incentives provided in the form of AIG supports works better for controlling illegal logging than forest law enforcement in areas in which poverty and lack of employment are pervasive. In addition enforcement of forest law alone could contribute towards a

more complicated vicious cycle of illegal logging, conflicts, and mistrust between forest managers and local forest users, for whom illegal logging is the easiest and often the only way to meet their livelihood needs. Again, economic incentives although were found to be very successful, there are always some uncertainties with donor-funded projects, a sustainable financing scheme based on protecting local resources is imperative to ensure the sustainability of forest resources. Building capacities to attract more secure funding from external sources through globally approved mechanisms (e.g. REDD+ (Reducing Emissions from Deforestation and Forest Degradation)) could also be useful.

Based on our respondents' survey and stakeholders' interviewees we recommend that, the government and the FD should emphasize three different but related aspects to control illegal logging. These are: i) community and livelihood development, ii) market regulation, and iii) institutional and regulatory reform. Creation of more income-generating opportunities, securing greater participation and community consultation in local forest management decisions, and recognizing customary forest use and rights of the people can aid community and livelihood development. Market regulation can be achieved through regular monitoring of local sawmills, the furniture industry, and timber-based enterprises and through certification of timber sources and products and careful monitoring of the transportation routes of timber and timber products. Finally, strengthening the capacity and staffing levels of the FD, reducing the gap between civil society, local forest users and forest managers, building trust and transparency, and delineating the boundaries of the forest reserves are only some of the strategies for effective institutional and regulatory reform.

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REFERENCES

ALAM, M. 2009. Evolution of forest policies in Bangladesh: A critical analysis. *International Journal of Social Forestry* **2**: 149–166.

AMERICAN FOREST AND PAPER ASSOCIATION (AFPA). 2004. Illegal logging and global wood markets: the competitive impacts on the US wood products industry. AFPA, 22 p.

AUSTRALIAN GOVERNMENT. 2006. Bringing down the axe on illegal logging - a practical approach. Department of Agriculture, Fisheries and Forestry, Australian Government. Canberra.

BISWAS, S.R. and CHOUDHURY, J.K. 2007. Forests and forest management practices in Bangladesh: the question of sustainability. *International Forestry Review* **9**: 627–640.

CERUTTI, P.O. and TACCONI, L. 2008. Forests, illegality, and livelihoods: the case of Cameroon. *Society and Natural Resources* **21**: 845–853.

CHAMPION, H.G. 1936. A preliminary survey of the forest types of India and Burma. Indian Forest Records (New Series) 1, 1.

CHHETRI, B.B.K., LARSEN, H.O. and SMITH-HALL, C. 2012. Law enforcement in community forestry: Consequences for the poor. *Small-scale Forestry* **11**: 435–452.

CHOWDHURY, M.S.H., KOIKE, M. and MUHAMMED, N. 2009. Embracing collaborative protected area management for conservation: an analysis of the development of the forest policy of Bangladesh. *International Forestry Review* **11**: 359–374.

CHOWDHURY, M.S.H., GUDMUNDSSON, C., IZUMIYAMA, S., KOIKE, M., NAZIA, N., RANA, M.P., MUKUL, S.A., MUHAMMED, N. and REDOWAN, M. 2014. Community attitudes toward forest conservation programs through collaborative protected area management in Bangladesh. *Environment Development and Sustainability*, DOI:10.1007/s10668-014-9524-y.

CHOWDHURY, M.S.H., KOIKE, M., RANA, M.P. and MUHAMMED, N. 2013. Community development through collaborative management of protected areas: evidence from Bangladesh with a case of Rema-Kalenga Wildlife Sanctuary. *International Journal of Sustainable Development & World Ecology* **20**: 63–74.

CONTRERAS-HERMOSILLA, A. 2001. Illegal forest activities in the Asia Pacific Rim. Pacific Rim Initiative, Forest Trends, Washington DC, USA.

CONTRERAS-HERMOSILLA, A. 2002. Law compliance in the forestry sector - an overview. The World Bank, Washington DC, USA.

DEFRIES, R., KARANTH, K.K., PAREETH, S. 2010. Interactions between protected areas and their surroundings in human-dominated tropical landscapes. *Biological Conservation* **143**: 2870–2880.

DEPARTMENT FOR INTERNATIONAL DEVELOPMENT (DFID). 2007. Crime and persuasion: tackling illegal logging, improving forest governance. DFID, London.

DOWNES, D. and ROCK, P. 1995. Understanding deviance: a guide to the sociology of crime and rule-breaking, 2nd edn. Clarendon Press, Oxford.

EUROPEAN UNION (EU). 2003. Forest law enforcement, governance and trade (FLEGT) - proposal for an EU action plan. Commission of the European Communities, Brussels, Belgium.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO). 2009. State of the world's forests 2009. FAO, Rome, Italy.

GEIST H.J. and LAMBIN, E.F. 2002. Proximate causes and underlying driving forces of tropical deforestation. *BioScience* **52**: 143–150.

GOVERNMENT OF BANGLADESH (GOB). 1994. Forestry master plan: main plan. Ministry of Environment and Forest, (UNDP/FAO BGD 88/035), Dhaka.

HALIM, M.A., SHAHID, A., CHOWDHURY, M.S.H., NAHAR, M.N., SOHEL, M.S.I., JAHANGIR, N.M. and KOIKE, M. 2008. Evaluation of land-use pattern change in West Bhanugach Reserved Forest, Bangladesh, using remote sensing and GIS techniques. *Journal of Forestry Research* **19**: 193–198.

HIRAKURI, S.R. 2003. Can law save the forest? Center for International Forestry Research (CIFOR), Bogor, Indonesia.

HUTTON, J.M. and LEADER-WILLIAMS, N. 2003. Sustainable use and incentive-driven conservation: realigning human and conservation interests. *Oryx* **37**: 215–226.

IFTHEKAR, M.S. and HOQUE, A.K.F. 2005. Causes of forest encroachment: an analysis of Bangladesh. *GeoJournal* **62**: 95–106.

INOGUCHI, A., SORIAGA, R. and WALPOLE, P. 2005. Approaches to controlling illegal forest activities: considerations from Southeast Asia, 1st edn (Working Paper Series No. 7). Asia Forest Network (AFN), The Philippines.

JACHMANN, H. 2008. Monitoring law-enforcement performance in nine protected areas in Ghana. *Biological Conservation* **141**: 89–99.

KAIMOWITZ, D. 2003. Forest law enforcement and rural livelihoods. *International Forestry Review* **5**: 199–210.

KAIMOWITZ, D. and ANGELSEN, A. 1998. Economic models of tropical deforestation: a review. Center for International Forestry Research (CIFOR), Bogor, Indonesia.

KHAN, N.A. 2001. Regional study on forest policy and institutional reform, final report of the Bangladesh case study. Manila: Asian Development Bank.

LAURENCE, W.F. 2007. Forest destruction in tropical Asia. *Current Science* **93**: 1544–1550.

MACKENZIE, C.A., CHAPMAN, C.A. & SENGUPTA, R. 2011. Spatial patterns of illegal resource extraction in Kibale National Park, Uganda. *Environmental Conservation* **39**: 38–50.

MACKINNON, J.R. 1997. Protected areas systems review of the Indo-Malayan realm. The Asian Bureau for Conservation Limited, England. pp. 69–73.

MAZUMDER, A.H., DECOSSE, P., SHARMA, R. and AHMAD, I.U. 2007. Forest conservation in Bangladesh: tracing its ebb and flow in recent decades, with observations for the future. Paper presented in international conference 'The Future of Forests in Asia and the Pacific: Outlook for 2020' held in October 16–18, 2007 at Chiang Mai, Thailand.

MILLAT-E-MUSTAFA, M. 2002. A review of forest policy trends in Bangladesh. *Policy Trend Report* **2002**: 114–121.

MIR, J. and FRASER, A. 2003. Illegal logging in the Asia-Pacific region: an ADB perspective. *International Forestry Review* **5**: 278–281.

MUKUL, S.A. and QUAZI, S.A. 2009. Communities in conservation: changing protected area management and enhanced conservation in Bangladesh. In: Leslie, R.N. (ed). Proceedings of the international conference; 'The Future of Forests in Asia and the Pacific: Outlook for 2020' held in October 16–18, 2007 at Chiang Mai, Thailand. 143–159 pp.

MUKUL, S.A. 2008. The role of traditional forest practices in enhanced conservation and improved livelihoods of indigenous communities: case study from Lawachara National Park, Bangladesh. Proceedings of the 1st international conference on 'Forest Related Traditional Knowledge and Culture in Asia' held in Seoul, Korea during 5–10 October, 2008. 24–28 pp.

MUKUL, S.A., RASHID, A.Z.M.M, QUAZI, S.A., UDDIN, M.B. and FOX, J. 2012. Local peoples' response to co-management in protected areas: a case study from Satchari National Park, Bangladesh. *Forests, Trees and Livelihoods* **21**: 16–29.

MUKUL, S.A., UDDIN, M.B., RASHID, A.Z.M.M. and FOX, J. 2010. Integrating livelihoods and conservation in protected areas: understanding the role and stakeholder views on prospects for non-timber forest products, a Bangladesh case study. *International Journal of Sustainable Development and World Ecology* **17**: 180–188.

MUZAFFAR, S.B., ISLAM, M.A., FEEROZ, M.M., KABIR, M., BEGUM, S., MAHMUD, M.S., CHAKMA, S., HASAN, M.K. 2007. Habitat characteristics of the endangered Hoolock Gibbons of Bangladesh: the role of plant species richness. *Biotropica* **39**: 539–545.

OBIDZINSKI, K., ANDRIANTO, A. and WIJAYA, C. 2006. Timber smuggling in Indonesia, critical or overstated problem? Forest governance lessons from Kalimantan. Center for International Forestry Research (CIFOR), Indonesia.

PALONIEMI, R. and VAINIO, A. 2011. Legitimacy and empowerment: combining two conceptual approaches for explaining forest owners' willingness to cooperate in nature conservation. *Journal of Integrative Environmental Sciences* **8**: 123–138.

POFFENBERGER, M. (ed). 2000. Communities and forest management in South Asia. IUCN, DFID and Asia Forest Network, Indonesia.

RASHID, A.Z.M.M, CRAIG, D., MUKUL, S.A. and KHAN, N.A. 2013. A journey towards shared governance: status and prospects for collaborative management in the protected areas of Bangladesh. *Journal of Forestry Research*, **24**: 599–605.

SATAKE, A. 2007. The role of economic incentives and social norms in forest resource management. *Ecological Research* **22**: 21–22.

TACCONI, L. 2007. Illegal logging: law enforcement, livelihoods and the timber trade. Earthscan, London, UK.

TACCONI, L., BOSCOLO, M. and BRACK, D. 2003. National and international policies to control illegal forest activities - a report prepared for the Ministry of Foreign Affairs of the Government of Japan. Center for International Forestry Research (CIFOR), Indonesia.

TACCONI, L., OBIDZINSKI, K. and AGUNG, F. 2004. Learning lessons to promote forest certification and control illegal logging in Indonesia. Center for International Forestry Research (CIFOR), Bogor, Indonesia.

UDDIN, M.B., STEINBAUER, M.J., JENTSCH, A., MUKUL, S.A. and BEIERKUHNLEIN, C. 2013. Do environmental attributes, disturbances, and protection regimes determine the distribution of exotic plant species in Bangladesh forest ecosystem? *Forest Ecology and Management* **303**: 72–80.

UDDIN, M.S., MUKUL, S.A., KHAN, M.A.S.A., ASIF, C. A.A. and ALAMGIR, M. 2007. Comparative evaluation of co-management impacts on protected area: A case study from Lawachara National Park, Maulvibazar, Sylhet. *Journal of Forestry and Environment* **5**: 103–110.

VAN DER PLOEG, J., VAN WEERD, M., MASIPIQUENA, A.B. and PERSOON, G.B. 2011. Illegal logging in the Northern Sierra Madre Natural Park, the Philippines. *Conservation and Society* **9**: 202–215.

WORLD BANK. 2006. Strengthening forest law enforcement and governance: Addressing a systematic constraint to sustainable development. The World Bank, Washington DC.