

## Role of non-timber forest products in sustaining forest-based livelihoods and rural households' resilience capacity in and around protected area: a Bangladesh study†

Sharif Ahmed Mukul <sup>a,b,c\*</sup>, A. Z. M. Manzoor Rashid<sup>d</sup>, Mohammad Belal Uddin<sup>d</sup>  
and Niaz Ahmed Khan<sup>e</sup>

<sup>a</sup>Tropical Forestry Group, School of Agriculture and Food Sciences, The University of Queensland, Brisbane, Australia; <sup>b</sup>School of Geography, Planning and Environmental Management, The University of Queensland, Brisbane, Australia; <sup>c</sup>Centre for Research on Land-use Sustainability, Maijdi, Bangladesh; <sup>d</sup>Department of Forestry and Environmental Science, School of Agriculture and Mineral Sciences, Shahjalal University of Science and Technology, Sylhet, Bangladesh; <sup>e</sup>Department of Development Studies, University of Dhaka, Dhaka, Bangladesh

(Received 9 September 2014; final version received 25 March 2015)

People in the developing world derive a significant part of their livelihoods from various forest products, particularly non-timber forest products (NTFPs). This article attempts to explore the contribution of NTFPs in sustaining forest-based rural livelihood in and around a protected area (PA) of Bangladesh, and their potential role in enhancing households' resilience capacity. Based on empirical investigation, our study revealed that local communities gather a substantial amount of NTFPs from national park despite the official restrictions. Twenty seven percent households (HHs) of the area received at least some cash benefit from the collection, processing and selling of NTFPs, and NTFPs contribute to HHs' primary, supplementary and emergency sources of income. NTFPs also constituted an estimated 19% of HHs' net annual income, and were the primary occupation for about 18% of the HHs. HHs' dependency on nearby forests for various NTFPs varied vis-à-vis their socio-economic condition, as well as with their location from the park. Based on our case study, the article also offers some clues for improving the situation in PA.

**Keywords:** rural livelihood; resilience; NTFPs, national park; Bangladesh

### 1. Introduction

Forests and forest products have played a vital role in sustaining the livelihoods of poor, forest-dependent communities for centuries. According to the World Bank (2002), more than 1.6 billion people throughout the world rely on forests for their livelihoods, and some 350 million people depend solely on forests, both for their subsistence and incomes. Another study suggests that over two billion people, a third of the world's population, use biomass fuels, mainly firewood, to cook and heat their homes and rely on traditional medicines harvested from forests (Arnold, Kohlin, and Persson 2006). The same study

---

\*Corresponding author: [s.mukul@uq.edu.au](mailto:s.mukul@uq.edu.au)

†An abridged version of this paper is available at Fox, J., B. Bushley, S. Dutt, and S.A. Quazi. 2007. *Making Conservation Work: Linking rural livelihoods and protected areas in Bangladesh*, eds. Hawaii: East-West Centre and Dhaka: Nishorgo Support Project of Bangladesh Forest Department.

also finds that, in some 60 developing countries, hunting and fishing on forested land supplies over a fifth of people's protein requirements (Mery *et al.* 2005). During the past two decades, there has been an increased recognition of the significant role of various forest products for household food and livelihood security, with an appreciation of the major role that NTFPs play.<sup>1</sup> In fact, for a large number of people, NTFPs are still a more important resource than timber. Wunder (2000) estimated that smallholder families living in forest margins in diverse parts of the world earn between 10% and 25% of their household income from NTFPs. Another study suggests that tropical forests in parts of southeast Asia provide as much as \$50 per month per hectare to local people and that this comes only from exploiting NTFPs (Sedjo 2002). In recent times, NTFPs have also gained national and international attention due to their perceived conservation potential; there is a belief that the collection and use of NTFPs are ecologically less destructive than timber harvesting (Anderson 1990; Plotkin and Famolare 1992; Arnold and Ruiz Pérez 2001; Gubbi and MacMillan 2008; Mukul *et al.* 2010).

Asia is undoubtedly the world's largest producer and consumer of NTFPs (Vantomme, Markkula, and Leslie 2002); a study by de Beer and McDermott (1996) showed that about 27 million people in South East Asia rely on NTFPs. This situation is no different in Bangladesh, where the collection, processing, and selling of NTFPs provide major employment opportunities for the poorest rural population of nearly 300,000 people with an annual contribution of about Tk. 1.3<sup>2</sup> billion to the country's economy (Basit 1995; GoB 1993). The operation of small-scale enterprises and the manufacture of secondary products from major NTFPs like bamboos and rattans is also a low-cost but effective strategy for employment generation for semi-skilled laborers in urban-rural fringes in Bangladesh (Alamgir, Jashimuddin, and Bhuiyan 2005; Alamgir, Bhuiyan, and Jashimuddin 2006; Alamgir, Mezbahuddin, and Jashimuddin 2007; Mukul 2011; Mukul and Rana 2013).

Alongside a renewed focus on the role of NTFPs in conservation, the past few decades have also witnessed a growing interest and effort in establishing protected areas (PAs) worldwide as a key strategy to address the problem of massive forest and biodiversity loss (Hockings 2003; Watson *et al.* 2014). Currently, PAs are amongst the world's dominant land uses, covering more area than all the agricultural crops combined (UNEP-WCMC 2014). They are very often argued to be the most effective measure for conserving nature and natural resources, and are considered to be the cornerstone of many national and regional conservation strategies (Lewis 1996; Mulongoy and Chape 2004). In addition to their conservation role, another stated objective of establishing PAs is to promote a certain degree of equity in resource generation and distribution, and to contribute to people's livelihoods, especially the forest-dependent people living within the PA's locality (Gubbi and MacMillan 2008).

Our knowledge and understanding about the role of NTFPs vis-à-vis the lives and livelihoods of local communities in PAs are still inadequate (Mukul *et al.* 2010). Unfortunately, in many tropical, developing countries, traditional, forest-dependent people are either denied or are weakly recognized during the formulation and management of PAs (see, for example, Gadgil 1990; Gubbi and MacMillan 2008; Mukul and Quazi 2009; Mukul *et al.* 2008, 2012, 2014). A good number of studies have reported the importance and contribution of NTFPs in local, forest-reliant livelihoods in some tropical developing countries (see, for example, Malhotra *et al.* 1991; Ganesan 1993; Gunatilleke, Senaratne, and Abeygunawardena 1993; Townson 1995; Cavendish 2000; Malla 2000; Mallik 2000; Ambrose-Oji 2003; Mahapatra, Albers, and Robinson 2005). Only a few of these studies, however, focus on the situation in PAs where, ideally, there

is greater emphasis on conservation than on livelihoods (Gubbi and MacMillan 2008). Furthermore, due to a rapidly changing global environment and, sometimes due to unanticipated environmental events, such livelihoods are facing greater exposure to risk and vulnerabilities than at any time before (Fisher, Chaudhury, and Mccusker 2010). There is evidence that local communities depend on forests and associated natural resources to improve their capacity for resilience in such a context (Mertz *et al.* 2009; Fisher, Chaudhury, and Mccusker 2010).

Against this backdrop, our study was an attempt to explore the role of NTFPs in the life and livelihood of local people in and around a north-eastern PA in Bangladesh, as well as to understand the significance of NTFPs as a mean of improving households' resilience. As noted earlier, research on the subject is very limited, and this research, in its own modest ways, is expected to contribute to the gap in the literature, and also illuminate the process of better understanding the interconnectivity between NTFPs and local people, particularly in the context of PAs and thereby prompting a rethinking about existing PA management system at the policy planners' level.

## 2. Materials and methods

### 2.1 Background of the study site

To date, thirty seven PAs have been notified in Bangladesh,<sup>3</sup> under the International Union for Conservation of Nature's (IUCN) PA management categories II and IV, covering nearly 11% forest area of the country (Dudley 2008). For the present study, we purposively selected Satchari National Park considering its particular richness in biodiversity, convenient access from the capital city Dhaka and nearby Sylhet, and its broad representativeness of the mainstream PAs of the country (Uddin *et al.* 2013). The park is also one of the PAs in which a co-management approach was pioneered in the country (Mukul *et al.* 2014).

The word 'Satchari' comes from "seven streams" (locally called '*chara*') and refers to the streams that flow through the forest. The area of the park is 243 ha which comprise the forests of Raghunandan Hills Reserve within the Satchari Range (Uddin and Mukul 2007). Administratively the park is located in Chunarughat Upazilla (administrative entity; sub-district) of Habiganj district and is situated nearly 130 km north-east of capital city Dhaka. India borders the park on its southern part (Figure 1). Other adjacent areas are covered by tea estates, rubber gardens, agar plantations and paddy fields.

The vegetation of the park is evergreen, however, large-scale conversion of the indigenous forest cover to plantations has changed its classic forest type entity (Uddin *et al.* 2013). Now only 200 ha of land contain natural forests; the rest is secondary raised forest. It is also one of the last habitats of critically endangered Hollock gibbons (*Hoolock hoolock*) in the country, as well as in the sub-continent.

The park has an undulating topography with slopes and hillocks (locally called '*tilla*') ranging from 10 to 50 m in elevation. A number of small, sandy-bedded streams drain the forest, all of which dry out in the winter season after November. The annual average rainfall is 4162 mm. July is the wettest month having an average of about 1250 mm of rain, while December is the driest with no rainfall. May and October, the hottest months, have an average maximum temperature around 32 °C, while January is the coldest month when the minimum temperature drops to about 12 °C. The relative humidity of the study area is about 74% during December while it is over 90% during July–August.

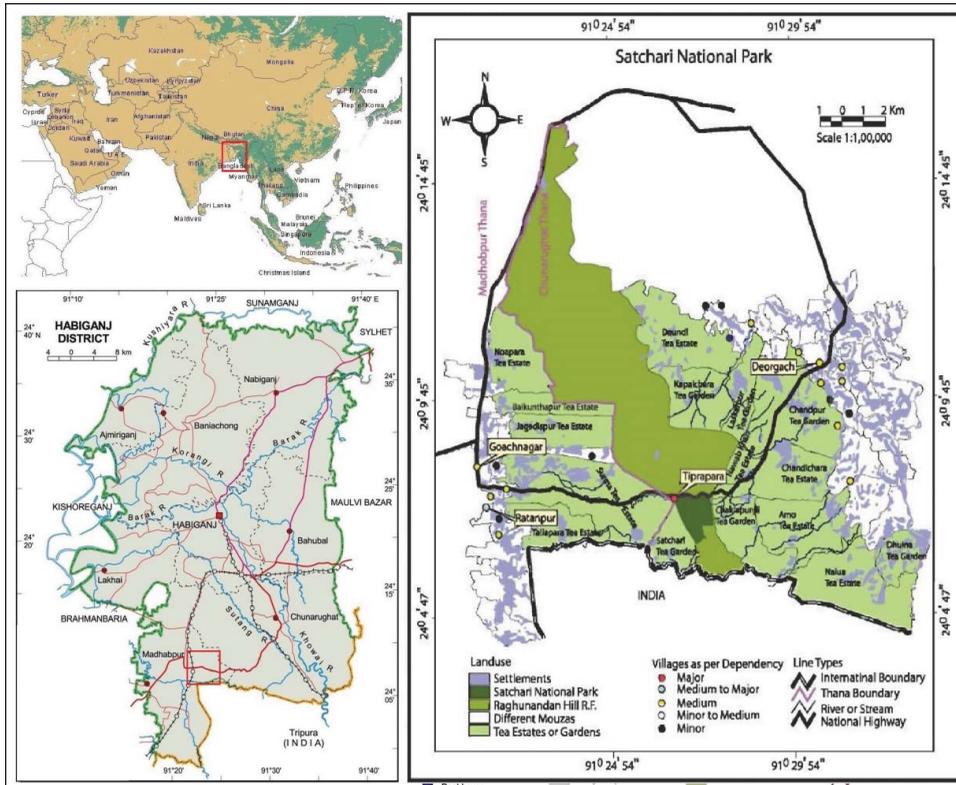


Figure 1. Location map of the study site. See online colour version for full interpretation.

### 2.2 Sampling protocol

A total of 19 villages with varied degrees of interests in the national park as well as in the reserved forest (RF) has been identified (Mollah, Kundu, and Rahman 2004). Of these villages, one village is located within the national park area and is inhabited by an ethnic community, the *Tripura* tribe. The other settlements that have stakes in the national park are located about 3–8 kilometers away from the park. Table 1 lists the degree of dependency that the various villages have on the RF as well as on the national park. Local people have traditionally collected various resources from the national park and adjacent RF. Many households, particularly poor households from the 19 villages

Table 1. Degree of dependency of various villages on the park and RF.

Degree of dependency	Name of the villages
Major	<i>Tiprapara</i>
Medium to major	<i>Gazipur, Ratanpur</i>
Medium	<i>Kalishiri, Ghanoshyampur, Doulatkhabad, Deorgach</i>
Minor to medium	<i>Baghbari, Teliapara, Goachnagar, Ektiarpur, Marulla, Nayani Bongaon</i>
Minor	<i>Shanjanpur, Rasulpur, Prommandapur, Bhaguru, Enatbad, Holholia</i>

Source: Mollah, Kundu, and Rahman (2004)  
 Note: Names of the study villages are italicized.

studied, rely entirely or partially on the RF as well as on the park for collecting firewood, timber, bamboo, herbal remedies, and other NTFPs.

### 2.3 Data collection

We collected both quantitative and qualitative data. We randomly selected one village from each of the first four 'forest dependence categories' as identified by Mollah, Kundu, and Rahman (2004), including the only village inside the park, Tiprapara. We did not consider any village with only a minor degree of dependence on the PA and adjacent RF. After preliminary field visits and a reconnaissance survey, however, we performed a necessary ranking change between Deorgach and Ratanpur, given the fact that the forest is more critical to the people of Ratanpur than to the people of Deorgach.

We conducted household surveys in four sample villages – Tiprapara, Ratanpur, Deorgach, and Goachnagar – within a one-year time span (January–December, 2006). Before household surveys, we arranged some focus group discussions to construct a community map and a community profile of the study villages (Table 2). We also conducted a number of field visits to observe and verify the information recorded during our community mapping exercises. We interviewed 101 households in our four sample villages from a total households of 818 households within the survey villages.

Several methodological choices are available for assessing households' income and dependency on forests (see Wollenberg and Nawir 1998; Wollenberg 2000; IIED 2003; Vedeld *et al.* 2004). To measure a household's forest dependency, we considered the annual cash contribution of the forest to households' livelihoods. Accordingly, for convenience of data analysis during the time of the focus group discussions, the average incomes from the forest for three distinct forest dependency categories were estimated respectively as: Tk. 54,000 per annum or above for the most forest-dependent category; Tk. 54,000–Tk. 24,000 per annum for the moderately forest-dependent category; and below Tk. 24,000 per annum for the least forest-dependent category. Additionally, households were categorized into three income classes: extremely poor households (those with monthly incomes below Tk. 2000); medium to poor households (those with monthly incomes below Tk. 7,500 but above Tk. 2,000); and rich households (those with monthly incomes of Tk. 7,500 or more). For estimating a household's net income from forest, we used following formula, as used by Ambrose-Oji (2003):

$$\text{Net forest income} = \text{Direct cash benefits from selling of all harvested forest products (revenue)} + \text{Market value of the consumed forest products which they may have otherwise purchased from the market (savings)} - \text{investment cost/opportunity cost.}$$

In Tiprapara, we took a 100% sample, as villagers were highly dependent on the park. In other villages, we took a 10% sample of households from each of the forest dependency classes using a stratified random sampling approach. During household surveys, we used a semi-structured questionnaire. The questionnaire allowed us to record details about the households' NTFPs and other products collection from the forest, quantity harvested, frequency of harvesting, the forest origin and final use (consumed, traded, or gifted) of these products, and income from various forest products (i.e. NTFPs, timber and others). We additionally collected information on market potential of different NTFPs available in the area and their possible contribution to the households' socio-economic advancement. We performed Students *t*-test and analysis of variance

Table 2. Profile of the study villages.

Village	Location and distance	Population size (HHs)	Sample size ( <i>n</i> )	Forest practices*
Tiprapara	Inside (0 km)	22	<i>n</i> = 22	Collect fuelwood, house building materials, fruits and other NTFPs, cultivate lemon and others
Ratanpur	Outside (2 km)	156	<i>n</i> = 16	Mainly involved with illegal tree felling, and collecting fuelwood
Deorgach	Outside east (3 km)	316	<i>n</i> = 31	Mainly collect fuelwood, some involved with illegal tree felling
Goachnagar	Outside west (4 km)	328	<i>n</i> = 32	As above

\*As described by Mollah, Kundu, and Rahman (2004)

(ANOVA) to compare the means as well as to check any significant difference between the observations.

### 3. Results

#### 3.1 Rural livelihoods in and around Satchari

The primary occupation observed in the study villages were: agriculture (37%), mainly paddy cultivation, followed by NTFP extraction (18%), timber poaching (18%), day labor (15%), small business (5%), government and non-government services (4%), and overseas employment (2%). The scenario was different in Tiprapara; as there was no land suitable for agricultural practice the villagers were found to work mostly as day labor (38.5%) followed by NTFPs extraction (mainly firewood, some 32%). Forest patrolling was the main service performed by the residents of Tiprapara. In addition, day laborers from all the villages also collected firewood in their off days and during agricultural off periods. Based on the income classes as described earlier 37% of the HHs were extremely poor followed by medium to poor (32%) and rich (31%). The literacy rate across the villages was, however, quite satisfactory.

#### 3.2 Households dependency on forests

About 13% of the HHs in the sampled villages were highly dependent on the forest for their livelihoods, whereas, the remaining HHs were moderately or least dependent on the forest (Figure 2). The dependency rate, however, varies with their location and with socio-economic condition of the corresponding HH. In Tiprapara, dependency rate was significantly high ( $F = 2.72$ ;  $p = 0.11$ ) due to its location within the national park. In Tiprapara, the majority (67%) of the people were mostly dependent on the park for their livelihoods ( $t = 5.94$ ,  $p \leq 0.01$ ), whereas 29% of the people from Ratanpur were moderately dependent on the park for their livelihoods ( $t = 3.38$ ,  $p \leq 0.05$ ).

Figure 3 shows the relative financial contribution of major livelihood activities among the HHs in Satchari area. Agriculture was the major source of income of HHs in the villages, contributing 30% of their annual income, followed by small-scale business

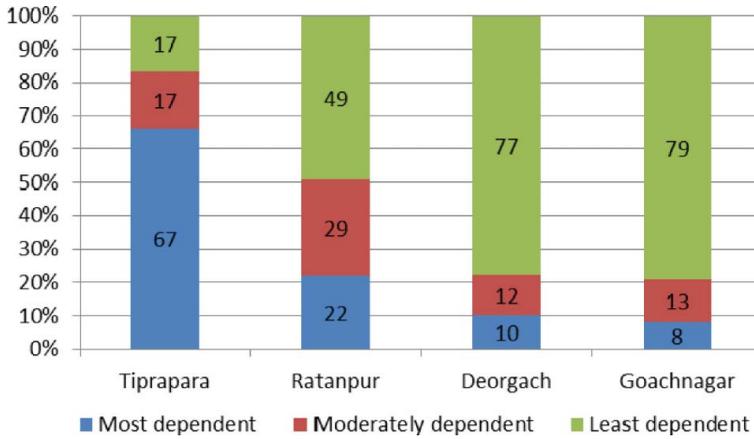


Figure 2. Forest dependency across the study villages.  
See online colour version for full interpretation.

(21%). Collection and selling of various NTFPs constituted about 19% of HHs annual income, followed by (illegal) timber poaching from the RF (11%). In Tiprapara, all the households depends on the forest for their domestic biomass fuel requirement for cooking. They also cultivated lemons in a confined area of the PA designated by the park authority.

### 3.3 The collection and use of NTFPs

Altogether we found 14 different NTFPs which households harvested either from the national park (PA) or from the surrounding forests (RF) regularly or occasionally

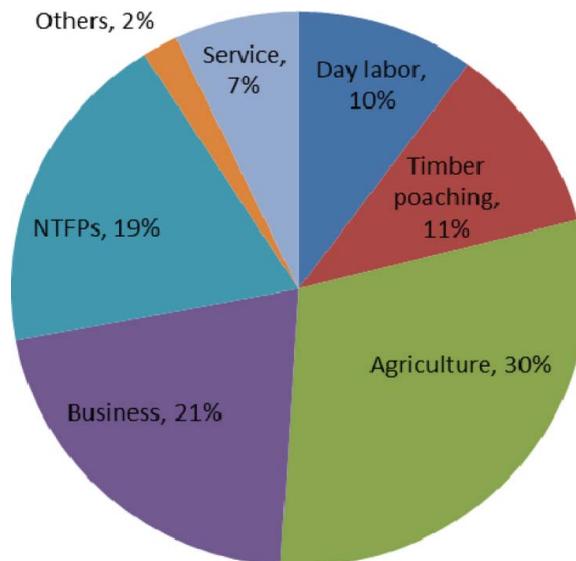


Figure 3. Relative financial contribution of different sectors to local livelihoods in Satchari.  
See online colour version for full interpretation.

Table 3. Different NTFPs exploited from the Satchari National Park (SNP) and adjacent forests by local communities.

Products	Biological origin	Extent of collection*	Source**
Bamboo	<i>Bambusa vulgaris</i> Schard. <i>Melocanna baccifera</i> Roxb.	Medium	PA, RF
Broomsticks	<i>Thysanolaena maxima</i> Roxb.	Medium	PA
Bushmeat	—	Very low	PA, RF
Firewood	All woody species	High	PA, RF
Forage and fodder	—	Low	RF
Fruits	<i>Artocarpus heterophyllus</i> Lamk. <i>Artocarpus chaplasha</i> Roxb. <i>Artocarpus lakoocha</i> Roxb. <i>Citrus limon</i> L. <i>Syzygium</i> spp.	Low	PA, RF
Honey	<i>Apis florae</i> <i>Apis dorsata</i>	Very low	RF, PA
Kumbi leaf	<i>Careya arborea</i> Roxb.	Medium	PA
Medicinal plants	—	Low	PA, RF
Menda bark	<i>Litsea monopetala</i> (Roxb.) Pers.	Medium	PA, RF
Rattan	<i>Calamus guruba</i> Ham. <i>Daemonorops jenkinsianus</i> Mart.	Low	RF, PA
Sand	—	Medium	PA, RF
Sun grass	<i>Imperata cylindrica</i> L.	Medium	PA, RF
Taragota	<i>Ammomum aromaticum</i> Roxb.	Medium	PA

\*Based on people's perception

\*\*PA – protected area, i.e. Satchari National Park; RF – reserved forest, sequence indicates their relative importance as source.

(Table 3). However, only a few of these made a significant contribution to HHs income. Mainly five NTFPs – firewood; medicinal bark of *menda*; *taragota*, which is used as a substitute of cardamom; bamboo; and *tendu* leaves, which are used to wrap tobacco – account for more than 90% of NTFPs-based income in the area. Collections of those NTFPs, however, were not identical in all the villages. All the HHs of Tiprapara collected firewood from the area, while 60%, 55%, and 56% HHs respectively from Ratanpur, Deorgach, and Goachnagar collected firewood from the area (Figure 4). Besides, *taragota* was mostly collected by the villagers of Ratanpur ( $t = 3.93$ ,  $p = 0.29$ ) and *menda* bark was found to be collected mostly by the people of Deorgach ( $t = 4.14$ ,  $p = 0.26$ ). Medicinal plants possessed a great diversity among NTFPs in the area; approximately 25% households from the study villages reported using at least certain medicinal plants for treating common ailments. During the survey, we recorded a total of forty medicinal plants with regular uses in the area (see Mukul, Uddin, and Tito 2007 for detail).

Households were found to collect NTFPs both from the PA as well as from the RF (Table 3). About 36% of the respondents collected NTFPs only from the PA, and 41% reported both PA and RF as their NTFPs source where the rest (23%) mentioned RF as their sole source of collection. The three major commercial NTFPs – firewood, *taragota*, and *kumbi* leaf were mainly collected from the PA. Other NTFPs like, fruits, sungrass, bamboo, *menda* bark, and broomsticks were also collected from the PA, but the major proportion actually came from the surrounding RF.

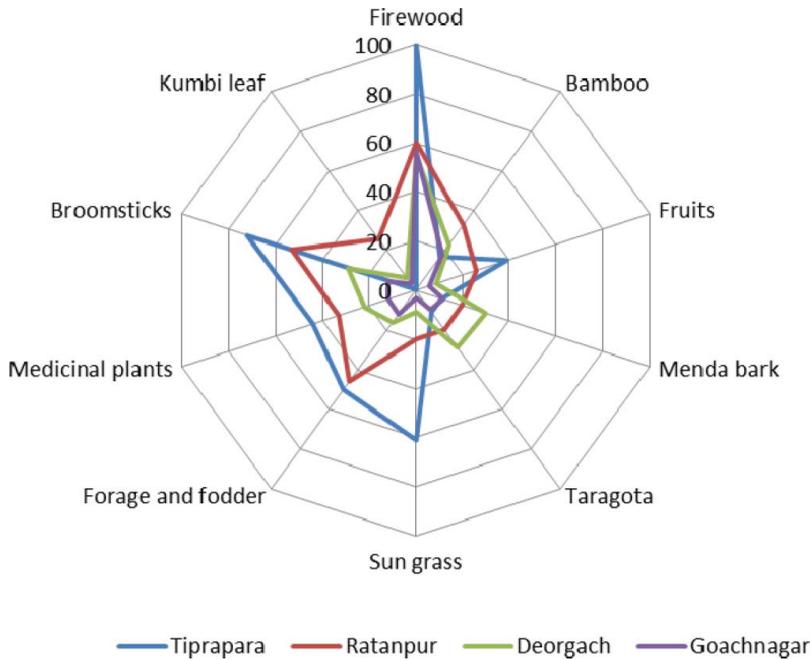


Figure 4. Households' involvement (%) in different NTFPs collection in Satchari. See online colour version for full interpretation.

### 3.4 The importance of NTFPs to local livelihoods

NTFPs were found to be critically important as HHs primary, supplementary, and emergency sources of income. Twenty seven percent of the sample HHs received at least some cash income from the extraction and trading of NTFPs. This contributed on an average 19% of HH's net annual income. Again, collections, processing, and sale of NTFPs constituted primary occupation for approximately 18% of the HHs. This study revealed that, HHs belonging to the extremely poor category received the maximum financial benefits from NTFPs ( $t = 1.50$ ,  $p = 0.27$ ), and medium to poor HHs were moderately dependent on NTFPs for their income ( $t = 2.52$ ,  $p = 0.12$ ). The importance of NTFP-based income across the three distinct income groups are shown in Figure 5. The net yearly income from NTFPs per HH varied between Tk. 2,500 and Tk. 25,000, (i.e. Tk. 40 and Tk. 120 daily).

When considering the trade, firewood was the most collected NTFPs in the area, and people brought it to the local market to directly sell to consumers or to retail shops. The other commercially important NTFPs were: dried *taragota*, which was purchased by middlemen (intermediary agents), who in their turn sold it to the *Ayurvedic* medicine (a form of herbal medicine) company located in the capital city Dhaka; and *menda* bark, which was directly sold to the local *menda* based mosquito repellent factories as a raw ingredient. Bamboo, another important NTFP was also sold to the local market directly by the collectors themselves. Some other NTFPs such as sungrass, broomsticks, fruits, medicinal plants, rattan, and sand were mainly collected for households' self consumption and rarely sold to the local markets, although they also possess a great market value. Rich HHs owned the majority of the NTFPs-based enterprises and retail shops in the area and profited mostly (i.e. got maximum returns on their investments)

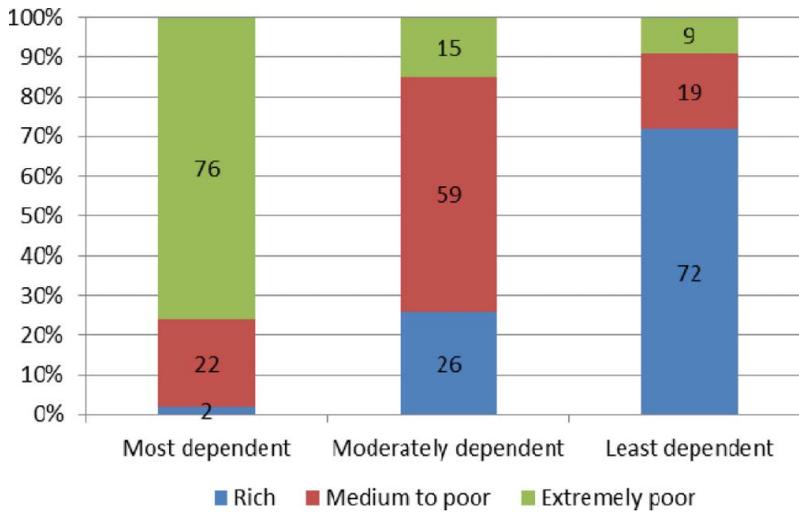


Figure 5. Comparison of financial gain from forest and NTFPs among different income groups. See online colour version for full interpretation.

from the trading of NTFPs, although they were not essentially involved in the collection and gathering of NTFPs. This is due to the limited access of rural NTFPs collectors to regional markets, poor storage, and poor technical facilities.

### 3.5 NTFPs as a mean of improving households' resilience during emergencies

The dependency of HHs on NTFPs in the area was limited to 18% and 19% in terms of primary occupation and contribution to their net annual income, but NTFPs were found to contribute considerably during tough economic situations. Such situations were attributed to agricultural crop failure; reduction in the price of the agricultural crops they produced; increases in the price of essential farm materials like irrigation, fertilizers and labor; natural catastrophies in the area, like flood and drought; monetary inflation limiting households buying capacity; and disease of family members incurring unplanned cost related to treatment. Table 4 below summarizes the households' opinions on the role of NTFPs during such harsh situations as an option to increase their capacity for resilience.

## 4. Discussion

Although the present study covers only one PA of Bangladesh, we believe it fairly represents the overall situation in PAs throughout the country, a country overwhelmed with high population density, resource scarcity, and extreme pressure on its limited forests (Mukul *et al.* 2010, Sohel, Mukul, and Burkhard 2014). Our study could also potentially represent other parts of south and south-east Asia that possess similar socio-political and economic features. In Satchari, we observed a strong link between poverty and dependence on forest, and forests were more important to low-income than to high-income people. In the area, the forest contributed to nearly all the aspects of rural life; providing food, fodder, fuel, medicines, and building materials, as well as intangible benefits which are difficult to measure in terms of monetary value. Local inhabitants have

Table 4. Respondents' responses on the perceived value of NTFPs in households' resilience.

Comment/opinion	Number of respondents		
	Yes	No	No idea/comment
NTFPs keep open an option to depend on during the time of emergencies	49	6	46
NTFPs contribute directly to HH's adaptation strategies	36	47	18
NTFPs contribute indirectly to HH's adaptation strategies	41	36	24
NTFPs increases HH's resilience capacity	61	12	28

traditionally used the national park and the RF for sustaining their livelihoods. It was, however, apparent that, dependencies of HHs on national park and RF increased with the decrease of their distance from the forest, and HHs with higher socio-economic status depend less on forests. These are in accordance with the findings of Davidar *et al.* (2010) and Fisher, Chaudhury, and Mccusker (2010) who also found location of the HHs as an influential factor in HHs' forest products collection respectively in India and Malawi. The dependency of poorest people on NTFPs-based income is also evident from the study of Cavendish (2000) and Malhotra *et al.* (1991) conducted respectively in Zimbabwe and India. The greater significance and dependence on NTFPs of low-income communities (compared to high-income groups) is also apparent from the work of Falconer (1992), Cavendish (1997), Pimentel *et al.* (1997), Neumann and Hirsch (2000), and Angelsen and Wunder (2003).

Twenty seven percent of the HHs in our study, most of which were poor to extremely poor, received at least some cash benefits from NTFPs, that constituted an estimated 19% of HH's net annual incomes, and NTFPs were a primary source of earnings for about 18% of the HHs. These figures are comparable with the findings of Das (2005), who assessed the role of NTFPs among forest villagers of the Buxa Tiger Reserve (a PA) in India. Das (2005) found that 54% of the households of the reserve were dependent on NTFPs, with 26% of the HHs reported that, NTFPs were their major source of income comprising 40% of their net annual income. Table 5 compares the finding of our study with several earlier studies that also presents the extent of contribution of NTFPs to local livelihoods in and around PAs. In Satchari area, we observed that the poorer people failed to optimize the profits they might have earned from selling NTFPs because of limited access to technology, capital, and market facilities. They were overwhelmingly

Table 5. The extent of the contribution of NTFPs to local people's cash income: some examples.

Country	Estimates of contribution	Author(s)
Orissa, India	19%	Mahapatra, Albers, and Robinson (2005)
Jharkhand, India	11%	Mahapatra, Albers, and Robinson (2005)
Cameroon	15%	Ambrose-Oji (2003)
Zimbabwe	22%–35%	Cavendish (2000)
Tamil Nadu, India	24%	Ganesan (1993)
Sri Lanka	21%	Gunatilleke, Senaratne, and Abeygunawardena (1993)
West Bengal, India	17%	Malhotra <i>et al.</i> (1991)

dependent on intermediaries to dispose of the products they obtained, a phenomenon also mentioned in the studies of Arnold and Ruiz-Perez (2001) and Shackleton and Shackleton (2004).

Shackleton and Shackleton (2004), in a study in South Africa, reported the role of NTFPs as a safety net during the time of emergencies. Fisher, Chaudhury, and Mccusker (2010), in Southern Malawi, found that local communities, in response to climate-induced vulnerabilities and food shortages, depend on forests as a key coping strategy. They did this by sourcing tubers and forest fruits to meet their dietary requirements, and through sourcing timber and NTFPs to supplement their incomes (Fisher, Chaudhury, and Mccusker 2010).

## 5. Conclusion

Our study has reiterated the critical role of NTFPs in providing subsistence and cash incomes to local communities, especially to the poorer groups, and as a provisioning option during unforeseen events that improves HHs' resilience capacity. Recent renewed emphasis on conservation in PAs sometimes leads to restrictions on extraction of NTFPs. Such restrictions need to be viewed and considered within the broader context and reality of the high degree of dependence of poorer communities on NTFPs. A degree of flexibility in existing PA management may be warranted, such as by setting an allowable resource extraction limit for deserving community members in the light of both ecological and economic sustainability. Some species are particularly vulnerable to over-exploitation, and require special attention from PA managers. *L. monopetala*, in our study, for example, has experienced serious depletion due to unsustainable bark collection and rampant illegal removal. Policy-makers and park managers should consider improving awareness of local communities about sustainable harvesting of NTFPs. They could also allow them to cultivate commercially important NTFPs in buffer zones to reduce pressure on core PAs. Another important issue is the lack of organized and equitable market outlets and facilities for local forest dependent communities to sell the NTFPs they collect. It makes them entirely dependent on an exploitative network of intermediaries. PA managers could therefore also facilitate direct and wider access of the poorer HHs to markets.

## Acknowledgements

We extend our gratitude to the local communities and participants in the study area (Tiprapara, Ratanpur, Deorgach, and Goachnagar). Thanks to Mr Mashiur R.Tito and Mr MASA Khan for accompanying us during the field visits. Our thanks are also due to Dr Brian Bushley and Dr Shimona A. Quazi of University of Hawaii for their invaluable feedback on an earlier version of this work, and USAID – Bangladesh for funding the fieldwork. The valuable feedback from the anonymous reviewers and editor also greatly improved the quality of this manuscript.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Notes

1. According to the Food and Agriculture Organization of the United Nations (FAO), NTFPs are products of biological origin other than wood derived from forests, other wooded land, and

trees outside forests. Examples include fruits, firewood, bamboo, rattans, medicinal plants, spices, wildlife, and wildlife products.

2. At the time of this study, US1\$ = Tk. 69 (69 Bangladesh Taka).
3. See, for more detail, <http://www.bforest.gov.bd/index.php/protected-areas> (accessed on 11 December 2014).

## ORCID

Sharif Ahmed Mukul  <http://orcid.org/0000-0001-6955-2469>

## References

- Alamgir, M., M.A.R. Bhuiyan, M. Jashimuddin, and M.S. Alam. 2006. "Economic Profitability of Cane Based Furniture Enterprises of Chittagong City Corporation Area, Bangladesh." *Journal of Forestry Research* 17: 153–156.
- Alamgir, M., M. Jashimuddin, and M.A.R. Bhuiyan. 2005. "Employment Generation and Economics of Cane Based Furniture Enterprises of Chittagong, Bangladesh." *Journal of Bamboo and Rattan* 4: 279–292.
- Alamgir, M., M. Mezbahuddin, and M. Jashimuddin. 2007. "Role of Bamboo Based Cottage Industry in Economic Upliftment of Rural Poor of Chittagong, Bangladesh." *Journal of Bamboo and Rattan* 6: 157–164.
- Ambrose-Oji, B. 2003. "The Contribution of NTFPs to the Livelihoods of the 'Forest Poor': Evidence from the Tropical Forest Zone of South-West Cameroon." *International Forestry Review* 5: 106–117.
- Anderson, A.B. 1990. *Alternatives to Deforestation: Steps Towards Sustainable Use of the Amazon Rain Forest*. New York: Columbia University Press.
- Angelsen, A., and S. Wunder. 2003. "Exploring the Forest–Poverty Link: Key Concepts, Issues and Research Implications." *CIFOR Occasional Paper* 40. Bogor: Center for International Forestry Research (CIFOR).
- Arnold, J.E.M., J. Kohlin, and R. Persson. 2006. "Woodfuels, Livelihoods, and Policy Interventions: Changing Perspectives." *World Development* 34: 596–611.
- Arnold, J.E.M., and M. Ruiz Pérez. 2001. "Can Non-Timber Forest Products Match Tropical Forest Conservation and Development Objectives?" *Ecological Economics* 39: 437–447.
- Basit, M.A. 1995. "Non-Wood Forest Products from the Mangrove Forests of Bangladesh." In *Beyond Timber: Social, Economic and Cultural Dimensions of Non-Wood Forest Products in Asia and the Pacific*, edited by P.B. Durst, and A. Bishop, 193–200. Bangkok: Food and Agriculture Organizations of the United Nations, Regional Office for Asia and the Pacific (FAO-RAP).
- Cavendish, M.W.P. 1997. "The Economics of Natural Resource Utilization by Communal Area Farmers of Zimbabwe." PhD thesis., University of Oxford.
- Cavendish, M.W.P. 2000. "Empirical Regularities in the Poverty-Environment Relationship of Rural Households: Evidence from Zimbabwe." *World Development* 28: 1979–2003.
- Das, B.K. 2005. "Role of NTFPs Among Forest Villagers in a Protected Area of West Bengal." *Journal of Human Ecology* 18: 129–136.
- de Beer, J.H., and M.J. McDermott. 1996. *The Economic Value of Non-Timber Forest Products in Southeast Asia*. 2nd revised ed. Amsterdam: Netherlands Committee for the International Union for Conservation of Nature (IUCN).
- Davidar, P., S. Sahoo, P.C. Mammen, P. Acharya, J. Puyravaud, M. Arjunan, J. P. Garrigues, and K. Roessingh. 2010. "Assessing the Extent and Causes of Forest Degradation in India: Where Do We Stand?" *Biological Conservation* 143: 2937–2944.
- Dudley, N. 2008. *Guidelines for Applying Protected Area Management Categories*. Gland: World Commission of Protected Areas-IUCN.
- Falconer, J. 1992. "A Study of the Non-Timber Forest Products of Ghana's Forest Zone." In *The Rainforest Harvest: Sustainable Strategies for Saving the Tropical Forests?*, edited by S. Cousell, and T. Rice, 135–141. London: Friends of the Earth.

- Fisher, M., M. Chaudhury, and B. Mccusker. 2010. "Do Forests Help Rural Households Adapt to Climate Variability? Evidence from Southern Malawi." *World Development* 38: 1241–1250.
- Gadgil, M. 1990. "India's Deforestation: Patterns and Processes." *Society and Natural Resources* 3: 131–141.
- Ganesan, B. 1993. "Extraction of Non-Timber Forest Products Including Fodder and Fuelwood in Mudumulai, India." *Economic Botany* 47: 268–274.
- GoB (Government of Bangladesh). 1993. *Forestry Master Plan: Participatory Forestry*. Dhaka: Asian Development Bank.
- Gubbi, S., and D.C. MacMillan. 2008. "Can Non-Timber Forest Products Solve Livelihood Problems? A Case Study from Periyar Tiger Reserve, India." *Oryx* 42: 222–228.
- Gunatilleke, H.M., D.M.A.H. Senaratne, and P. Abeygunawardena. 1993. "Role of Non-Timber Forest Products in the Economy of Peripheral Communities of Knuckles National Wilderness Area in Sri Lanka: A Farming Systems Approach." *Economic Botany* 47: 275–281.
- Hockings, M. 2003. "System for Assessing the Effectiveness of Management in Protected Areas." *BioScience* 53: 821–832.
- IIED (International Institute for Environment and Development). 2003. *Valuing Forests: A Review of Methods and Applications in Developing Countries*. London: International Institute for Environment and Development (IIED).
- Lewis, C. 1996. *Managing Conflicts in Protected Areas*. Gland: IUCN.
- Mahapatra, A.K., H.J. Albers, and E.J.Z. Robinson. 2005. "The Impact of NTFP Sales on Rural Households' Cash Income in India's Dry Deciduous Forest." *Environmental Management* 35: 258–265.
- Malhotra, K.C., M. Dutta, T.S. Vasulu, G. Yadav, and M. Adhikari. 1991. *Role of NTFP in Village Economy: A Household Survey in Jamboni Range, Midnapore District, West Bengal*. Calcutta: IIBRAD.
- Malla, Y.B. 2000. "Impact of Community Forestry on Rural Livelihoods and Food Security." *Unasylya* 202: 37–45.
- Mallik, R.M. 2000. "Sustainable Management of Non Timber Forest Products in Orissa: Some Issues and Options." *Indian Journal of Agricultural Economics* 55: 383–397.
- Mertz, O., C. Mbow, A. Reenberg, and A. Diouf. 2009. "Farmers' Perception of Climate Change and Agricultural Adaptation Strategies in RURAL SAHEL." *Environmental Management* 43: 804–816.
- Mery, G., R. Alfaro, M. Kanninen, M. Lobovikov, H. Vanhanen, and C. Pye-Smith, eds. 2005. *Forests for the New Millennium- Making Forest Work for People and Nature*. Vienna: International Union of Forest Research Organizations (IUFRO).
- Mollah, A.R., D.K. Kundu, and M.M. Rahman. 2004. *Site-Level Field Appraisal for Protected Area Co-Management: Satchari Reserve Forest*. Dhaka: Nature Conservation and Management (NACOM).
- Mukul, S.A. 2011. "Changing Consumption and Marketing Pattern of Non-Timber Forest Products in a Competitive World: Case Study from an Urban Area of North- Eastern Bangladesh." *Small-Scale Forestry* 10: 273–286.
- Mukul, S.A., J. Herbohn, A.Z.M.M. Rashid, and M.B. Uddin. 2014. "Comparing the Effectiveness of Forest Law Enforcement and Economic Incentive to Prevent Illegal Logging in Bangladesh." *International Forestry Review* 16: 363–375.
- Mukul, S.A., and S.A. Quazi. 2009. "Communities in Conservation: Changing Protected Area Management and Enhanced Conservation in Bangladesh." In *The Future of Forests in Asia and the Pacific: Outlook for 2020*, edited by R.N. Leslie, 143–159. Bangkok: FAO-RAP (FAO-RAP Publication no 2008/3).
- Mukul, S.A., and M.P. Rana. 2013. "The Trade of Bamboo (*Graminae*) and Secondary Products in a Regional Market of Southern Bangladesh: Status and Socio-Economic Significance." *International Journal of Biodiversity Science, Ecosystem Services & Management* 9: 146–154.
- Mukul, S.A., A.Z.M.M. Rashid, S.A. Quazi, M.B. Uddin, and J. Fox. 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., M.B. Uddin, A.Z.M.M. Rashid, and J. Fox. 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.

- Mukul, S.A., M.B. Uddin, and M.R. Tito. 2007. "Medicinal Plant Diversity and Local Healthcare Among the People Living in and Around a Conservation Area of Northern Bangladesh." *International Journal of Forest Usufructs Management* 8: 50–63.
- Mukul, S.A., M.B. Uddin, M.S. Uddin, M.A.S.A. Khan, and B. Marzan. 2008. "Protected Areas of Bangladesh: Current Status and Efficacy for Biodiversity Conservation." *Proceedings of the Pakistan Academy of Sciences* 45: 59–68.
- Mulongoy, K.J., and S.P. Chape. 2004. *Protected Areas and Biodiversity: An Overview of Key Issues*. Montreal: Secretariat of the Convention of Biological Diversity (SCBD).
- Neumann, R.P., and E. Hirsch. 2000. *Commercialisation of Non-Timber Forest Products: Review and Analysis of Research*. Bogor: CIFOR.
- Pimentel, D., M. Mcnair, L. Buck, M. Pimentel, and J. Kamil. 1997. "The Value of Forests to World Food Security." *Human Ecology* 25: 91–120.
- Plotkin, M.J., and L.M. Famolare. 1992. *Sustainable Harvest and Marketing of Rainforest Products*. Washington, DC: Island Press.
- Sedjo, R.A. 2002. "Tropical Forests and Poverty Alleviation – How Can Benefits be Captured?" In *Understanding and Capturing the Multiple Values of Tropical Forests*, edited by P. Verweij, 63–66. Wageningen: Tropenbos International.
- Shackleton, C., and S. Shackleton. 2004. "The Importance of Non-Timber Forest Products in Rural Livelihood Security and as Safety Nets: A Review of Evidence from South Africa." *South African Journal of Science* 100: 658–664.
- Sohel, M.S.I., S.A. Mukul, and B. Burkhard. 2014. "Landscape's Capacities to Supply Ecosystem Services in Bangladesh: A Mapping Assessment for Lawachara National Park." *Ecosystem Services* 12: 1–8, doi:10.1016/j.ecoser.2014.11.01.
- Townson, I.M. 1995. "Forest Products and Household Incomes: A Review and Annotated Bibliography." *Tropical Forestry Paper* 31. <http://www.bodley.ox.ac.uk/users/millsr/isbes/ODLF/TFP31.pdf>.
- Uddin, M.B., and S.A. Mukul. 2007. "Improving Forest Dependent Livelihoods Through NTFPs and Home Gardens: A Case Study from Satchari National Park." In *Making Conservation Work: Linking Rural Livelihoods and Protected Areas in Bangladesh*, edited by J. Fox, B. Bushley, S. Dutt, and S.A. Quazi, 13–35. Hawaii: East-West Centre and Dhaka: Nishorgo Support Project of Bangladesh Forest Department.
- Uddin, M.B., M.J. Steinbauer, A. Jentsch, S.A. Mukul, and C. Beierkuhnlein. 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.
- UNEP-WCMC (United Nations Environment Programme - World Conservation Monitoring Centre). 2014. *World Database on Protected Areas*. Cambridge. [www.protectedplanet.net](http://www.protectedplanet.net)
- Vantomme, P., A. Markkula, and R.N. Leslie. 2002. *Non-Wood Forest Products in 15 Countries of Tropical Asia: An Overview*. Bangkok: FAO-RAP.
- Vedeld, P., A. Angelsen, E. Sjaastad, and G.K. Berg. 2004. "Counting on the Environment: Forest Incomes and the Rural Poor." *Environmental Economics Series, Paper 98*. Washington, DC: The World Bank.
- Watson, J.E.M., N. Dudley, D.B. Segan, M. Hockings. 2014. "The Performance and Potential of Protected Areas." *Science* 515: 67–73.
- Wollenberg, E. 2000. "Methods for Estimating Forest Income and Their Challenges." *Society and Natural Resources* 13: 777–795.
- Wollenberg, E., and A.S. Nawir. 1998. "Estimating the Incomes of Peoples Who Depend on Forests." In *Incomes from the Forests - Methods for the Development and Conservation of Forest Products for Local Communities*, edited by E., Wollenberg and A. Ingles, 157–187. Bogor: CIFOR.
- World Bank. 2002. *A Revised Forest Strategy for the World Bank Group*. Washington, DC: The World Bank.
- Wunder, S. 2000. "Poverty Alleviation and Tropical Forests – What Scope for Synergies?" *World Development* 29: 1817–1833.