

CHAINSAW OPERATORS' PERCEPTION OF THE AVAILABILITY OF TIMBER RESOURCES AND THEIR WILLINGNESS TO PAY FOR TIMBER HARVESTING RIGHTS

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ABSTRACT

In recent times, chainsaw milling has generated protracted public debate, and has been pervasive and contested in the forest governance discourse in Ghana. Even though regularization of the activities of operators has been proposed as a viable option for dealing with the issue, operators' willingness to pay for timber harvesting rights has not yet been assessed. This paper presents results from a study that attempted to assess chainsaw operator's perception of the availability of timber resources and their willingness to pay to harvest timber. Results of the study indicate that chainsaw operators are willing to pay the FC for timber harvesting rights if their activities are captured under a regularized regime, although their preferences varied: 50 percent of the 50 operators interviewed preferred to pay tax on each timber tree harvested (product tax); 34 percent wanted to pay monthly or annual permit fees; and 14 percent wanted to pay tax on income accrued from chainsaw lumbering (income tax). In terms of the way in which chainsaw activities should be regularized, 74 percent of operators want concessions for registered groups of operators, 18 percent want individual permits to harvest individual trees (permit per tree harvested), while 6 percent want small concessions for individual operators. The paper concludes that rather than continuing with a ban which has not been effective in addressing indiscriminate logging, chainsaw operations need to be regularized to ensure that chainsaw operators pay appropriate taxes to the state for the trees they fell.

Keywords: Timber resources, chainsaw milling, timber harvest rights, willingness to pay, taxes

INTRODUCTION

Chainsaw milling and its associated trade have been banned since 1998. Despite this ban, the forest sector in Ghana is bedevilled by a very high incidence of 'illegal' chainsawing. The implementation of the ban has been very difficult and largely unsuccessful. The ban has failed to resolve the chainsaw conflict and it has led to forest officials spending a greater part of their time dealing with chainsaw operators, sometimes

in violent circumstances. Chainsaw lumbering operations continue and are currently reported by the Forestry Commission (FC) to be on the increase (Odoom, 2005). Much of the domestic supply of lumber is derived from 'illegal' chainsaw milling. For example, the Ghana wood industry and log ban export study (Birikorang *et al.*, 2001) estimated that in 1999 out of the 3.7 million m³ of timber harvested, illegal chainsaw activities accounted for 46 percent (1.7 million m³), while illegal industrial logging accounted for

a further 24 percent (0.9 million m³). The number of people indirectly involved in chainsaw milling is considerable, with estimates as high as 50,000 people (Otoo, 2004). Adam *et al.* (2007a) assert that if described according to the various operational phases (stump site, highway transportation, re-processing and marketing) the chainsaw business provides employment to about 80,000 people (see also Marfo and Acheampong, 2009).

One reason for its persistence is that chainsaw milling has undoubtedly provided benefits to both labourers and farmers, though inequitably. For example, the transportation of lumber by headload fetches daily rates more than five times the daily minimum wage (Bird *et al.*, 2006). Farmers often prefer instant payments for trees from illegal chainsawyers than promises from the forest sector institutions for benefits that are eventually distributed in a non-transparent way. Also, rural demand for wood has often only been met through strenuous access to distant markets, while the raw material has passed rural communities by. Above all, chiefs, as landowners, have been crowded out of decision making by the local government system and the Forestry Commission's (FC) presence at the district level. Consequently, they have often turned a blind eye to illegal logging (Birikorang, *et al.*, 2001.).

One of the options that have been proposed to deal with the 'illegal' chainsaw issue is legalization and regularization of chainsaw milling activities (see Acheampong and Marfo, 2009; Adam *et al.*, 2007a; Odoom, 2005). Even though regularization has been proposed as a viable option for dealing with 'illegal' chainsaw milling in Ghana, no study has been conducted to assess chainsaw operators' willingness to pay for timber harvest rights should the activity be regularized. To better understand the option of regularization, such an assessment is imperative. This paper presents results of a study about chainsaw operator's perception of the

availability of timber resources and their willingness to pay to harvest timber. In particular, the study was designed to answer the following research questions:

- What is the perception of chainsaw operators on the availability of timber resources?
- Are chainsaw operators willing to pay to harvest timber should chainsaw lumbering be legalized?
- How much are operators willing to pay for exploitation of different species of timber?
- What form of payment do chainsaw operators prefer?
- What form of timber harvest right/licence/permit is preferred by chainsaw operators?

The next section of the paper provides a brief review of the concept of willingness to pay and economic value. The subsequent section describes the methodology used for data collection and analysis. Following this, the results are presented and discussed. The final section concludes the paper and makes recommendations for addressing the chainsaw issue in Ghana.

The Concept of Willingness to Pay and Economic Value

Willingness to pay (WTP) as used in this study is defined as the maximum amount individuals are willing to pay for a good or service. Field (2001:44) defines total WTP for a given consumption level as "the total amount a person would be willing to pay to attain that consumption level rather than go without the good entirely". Willingness to pay is a fundamental economic concept of value. The economic value of any good or service is generally measured in terms of what we are willing to pay for the commodity, less what it costs to supply it. When an environmental resource provides products and services at no cost, then it is our willingness to pay alone which describes the value of the resource in providing

the commodities and/or services, whether or not we actually make any payment (Barbier *et al.*, 1997). The more a person values a good or service, the greater is his willingness to pay for that good or service (Field, 2001).

Measures of economic value are based on what people want – their tastes and preferences. Economists generally assume that individuals, not the government, are the best judges of what they want. Thus, the theory of economic valuation is based on individual preferences and choices (Field, 2001; Pearce and Turner, 1990). People express their preferences through the choices and tradeoffs that they make, given certain constraints, such as those on income or available time (King and Mazzotta, 2000). Using this notion of value, the economic value of a particular item, or good, for example a timber tree, is measured by the maximum amount of other things that a person is willing to give up to have that timber tree. Thus, economic value is measured by the most someone is willing to give up in other goods and services in order to obtain a good, service, or state of the world. In a market economy, money is a universally accepted measure of economic value, because the amount of money that a person is willing to pay for something tells how much of all other goods and services they are willing to give up to get that item. This is often referred to as “willingness to pay (WTP)” (King and Mazzotta, 2000).

Willingness to pay also reflects ability to pay and is dependent upon the state of one's knowledge and experience (Field, 2001). It is important to note that measuring the value of something using money does not require that it be bought and sold in markets. It only requires estimating how much purchasing power (money) people would be willing to give up to get it (or would need to be paid to give it up), if they were forced to make a choice.

It is often incorrectly assumed that a good's market price measures its economic value. However, the market price only tells us the minimum amount that people who buy the good are willing to pay for it. When people purchase a marketed good, they compare the amount they would be willing to pay for that good with its market price. They will only purchase the good if their WTP is equal to or greater than the price. Many people are actually willing to pay more than the market price for a good, and thus their values exceed the market price (Richards *et al.*, 2003; King and Mazzotta, 2000).

Generically, WTP can be estimated in two ways, namely by using revealed preference as observed in actual choices or expressed (stated) preference as observed in hypothetical choices in surveys (Boxall and Beckley, 2002). That is, how much people are willing and able to pay for a good or service can be assessed (a) by observing and modelling past utilisation, expenditure and responsiveness to prices; or (b) by asking people directly how much they would be willing to pay for the specified good or service.

One of the important applications of the concept of WTP is in the estimation of the benefits/values of environmental (including non-marketed) goods and services. Therefore, WTP offers great potential for policy makers as it provides a single measure of value, which is rooted in economic theory. Environmental valuation can be a difficult and controversial task, and economists have often been criticized for trying to put a “price tag” on nature (King and Mazzotta, 2000). However, agencies in charge of protecting and managing natural resources must often make difficult spending decisions that involve tradeoffs in allocating resources. These types of decisions are economic decisions, and thus are based, either explicitly or implicitly, on society's values. Therefore, economic valuation can be useful, by providing a way to justify and set priorities for

programs, policies, or actions that protect natural resources or restore ecosystems and their services. Thus, by estimating chainsaw operators' WTP for timber trees, we can have an idea about how much operators value the timber resource and what estimates to use in designing policy options that will require some potential payments.

METHODOLOGY

The study was conducted in three Forest Districts (Nkawie, Juaso and Goaso) due to their vast areas of off-reserve logging operations and their reputation of persistent 'illegal' chainsaw operations. The selection of the Forest Districts was based on expert advice from the Forestry Research Institute of Ghana (FORIG) and the regional office of the Forest Services Division (FSD). Five communities were visited in the three districts: Juaso and Obogu in the Juaso Forest District; Goaso and Akrodie in the Goaso Forest District; and Akota in the Nkawie Forest District. Guided by the qualitative criteria of Bernard (1995) suggesting that a sample size of 30-50 is adequate for such explorative study, a total of 50 chainsaw operators were purposively drawn from the five communities for the study. The selection considered only those operators that are actively involved in chainsaw milling.

Because of rural sensitivities and the illegality of the chainsaw milling business, contact with the operators was negotiated with the assistance of facilitators who are field staff of the FC and have been involved with the control or assessment of chainsawing in the past. The facilitators contacted the relevant respondents to arrange a date and time for the fieldwork. To overcome fear and mistrust, the researchers and facilitators held an introductory meeting with the operators where the study was introduced to them. The purpose of the study as well as its potential contribution to the lives of the operators was discussed. These

discussions were quite significant and helped to legitimize the study. The discussions helped to build rapport and trust between the researchers and the operators.

After contact with the operators, semi-structured questionnaires were used for data collection. The questionnaires were designed to obtain data on chainsaw operators' views and perceptions on the availability of timber resources; their willingness to pay for timber harvesting rights; the amount they are willing to pay for different species of timber; and the form of timber harvest payment and timber harvest right/licence/permit that is acceptable to chainsaw operators. An open-ended elicitation method was used to determine the amount chainsaw operators are willing to pay for timber trees. Following the principles of contingent valuation, the operators were asked directly to state the maximum amount they would be willing to pay for different species of timber trees.

Responses obtained through the questionnaire administration were assigned numerical codes and SPSS was used to summarise and analyse the data. Simple descriptive statistics and frequencies were generated. Cross tabulations of relevant variables were also done to reveal patterns and relationships.

RESULTS AND DISCUSSION

Chainsaw Operators' Perceptions of the Availability of Timber Resources

Changes in the meanings and perception of forests over the years have suggested that there is a dynamic relationship between humankind and forests. In the past, forests were generally viewed as obstacles to agricultural growth and development. Later, forests were viewed as a means of timber production to support increased

demand for wood products (Owubah *et al.*, 2001). However, the advent of environmentalism in developed countries, coupled with changing social values, and increased scientific understanding of human impacts on forest ecosystems have altered this perception dramatically. Today, forests are seen by some as objects to view and use non-consumptively while others see forests as a linkage with gods and spiritual powers (Yaffee, 1994; Schmithüsen, 1995, in Owubah *et al.*, 2001). These latter perceptions and views have influenced forest management in Ghana to the extent that even those who believe in the productive aspects of forests do not accept the massive clear cutting that characterised forest management decades ago (Owubah *et al.*, 2001). An important question is whether perceptions and values of forests among forest-dependent communities, including chainsaw millers, have

also changed. Perceptions of forests and of the availability of timber resources are critical factors that influence access to timber and the harvesting efforts applied by operators. Thus, an understanding of how local people view and value forests and timber resources and how these perceptions are changing is essential for the long term planning and management of forests.

To explore the pattern of change in the availability of timber resources, the operators were asked to indicate whether the availability of timber has changed since they entered the chainsaw milling enterprise and mention the reasons for the change. The majority of respondents (90%) reported that timber resources are less available today. Only 6% indicated that timber resources are more available. The remaining 4% claimed that there has not been any change in the availability of timber (Figure 1).

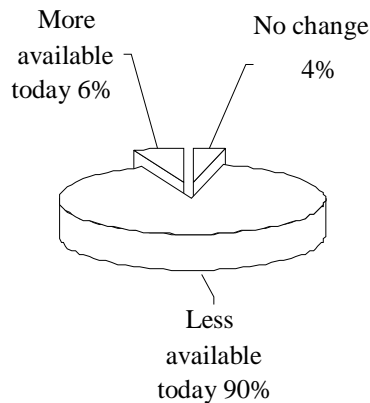


Figure 1: Availability of timber resources since operator entered the chainsaw enterprise (N = 50)

Table 1: Reasons for the decline in availability of timber resources (N=50)

Reasons	Number of* respondents	Percentage of* respondents
Uncontrolled harvesting by chain sawyers	36	72
Over-harvesting of forest resources by timber companies	36	72
Destructive harvesting practices	17	34
Forest fires	28	56
Clearance of forest areas for farming	15	30
Increase in human population	2	4

*Number and percentage of respondents do not add up to 50 and 100 respectively because of multiple responses

The respondents gave several reasons to explain the declining availability of timber resources, including uncontrolled harvesting by chainsawyers, over-harvesting of forest resources by timber companies, destructive harvesting practices, forest fires, clearance of forest areas for farming, and increase in human population (Table 1).

Several authors (Townson, 1995; Arizpe *et al.*, 1994; Olorunfemi, 1994; Falconer, 1992) have also identified these factors as contributing to the decline in availability of forest products in general. For example, in a study of incomes from forest-based enterprises in southern Ghana, 44% of proprietors of these enterprises mentioned land clearance for agriculture as an important reason for the decline in raw material availability (Townson, 1995). In a similar study, 70% of the survey households mentioned uncontrolled harvesting as an important cause of forest product decline (Acheampong, 2003). This decline may cause several problems. Marfo (2009) reports that the decline in timber resources may create serious

conflicts as chainsaw operators would increase competition with licensed loggers for trees. Moreover, with timber resources becoming scarce for chainsawyers, in the future operators might target protected areas and ecologically sensitive sites, such as Globally Significant Biodiversity Areas (GSBAs), as the last remaining areas with commercial timber trees. In order to prevent such problems, there is a need for reviewing the chainsaw ban and to institute a system that regulates the activities of operators and to get them to pay for timber.

Willingness to Pay to Harvest Timber

The willingness of chainsaw millers to pay to harvest timber trees is a critical factor to consider in any attempt to legalize or regularize the activity. Such information is of special reference in case that legalization and regularization are considered as a viable option for dealing with the chainsaw issue. To this end, the operators were asked whether they are willing to pay for timber should chainsaw milling be legalized. They were

also asked to indicate the form in which the payment should take.

All the respondents indicated that they are willing to pay to harvest timber if the activity is regularized. Majority (50%) of the respondents reported that the payment should take the form of a tax on each timber tree harvested (product tax), 34% mentioned a monthly or annual fee for the number of trees allocated to them, while 14% said that the payment should take the form of a tax on income accrued from chainsaw lumbering (income tax). Only one of the respondents was willing to pay all the fees that licensed loggers pay (Table 2).

The ban on chainsaw milling leads to loss of revenue to the government and all beneficiaries of timber royalties since operators pay no royalties or other official taxes or levies (Parren *et al.*, 2007). According to Marfo (2009) the loss of stumpage revenue to the state from 'illegal' chainsaw milling is estimated to amount to at least USD 18 million per annum. This exceeds the stumpage fees collected from licensed loggers. For example, between 2000 and 2003, the Forestry Commission (FC) collected an average of only USD 9.1 million per year from stumpage fees (Adam and Gyamfi, 2009; in Marfo, 2009). The above findings, however, suggest that chainsaw millers are willing to contribute towards stumpage fee payments if

the legal framework in Ghana creates an enabling environment for them to do so. Thus, the legalization and regularization of chainsaw milling may not only contribute towards a better controlled exploitation of forests and timber resources but will also contribute to improving rural livelihoods and increase the stream of forest revenue to the state through taxation of chainsaw millers.

The major taxes in forestry are product taxes, income taxes, taxes on factors of production, and property taxes (Klemperer, 2003; Price, 1998; Duerr, 1993). Taxes on forest products can be levied either at a flat rate or at a given proportion of untaxed price. The main effect of product taxes is a mark-up on the price to final consumers (Price, 1998). Income taxes may be levied on income derived from working in the forest, as in any other enterprise, or on income derived from forest ownership, that is, the profits of the enterprise. The tax may be a fixed proportion of income, regressive (i.e. taking a smaller proportion of larger incomes) or, more commonly, progressive (i.e. taking a larger proportion of larger incomes) (Price, 1998). Taxes can also be levied on factors of production. Taxes on products (such as the chainsaw itself) which become inputs in the production of other goods (such as lumber) are effectively taxes on factors of production, and they increase the cost of inputs (Klemperer, 2003).

Table 2: Views on the form in which timber harvesting payments should take

Form of payment (Tax)	Number of respondents	Percentage of respondents
All payments that licensed loggers pay	1	2
Only Tax on income accrued from chainsaw lumbering (income tax)	7	14
Only Tax on each timber tree harvested (product tax)	25	50
Monthly or annual fee for the number of trees allocated	17	34
Total	50	100

Amount Chainsaw Operators are Willing to Pay for Different Species of Timber

To get a rough idea of how much the operators are willing to pay for timber trees of harvestable size, they were asked to estimate the amount they are prepared to pay (per tree) for high quality trees - such as 'Odum' (*Milicia excelsa*), medium quality trees - such as 'Wawa' (*Triplochiton scleroxylon*) and 'Dahoma' (*Piptadeniastrum africanum*), and low quality trees - such as 'Onyina' (*Ceiba pentandra*). Even though the amounts elicited were not based on actual volume of timber but on harvested trees, they give an indication of the value chainsaw operators place on different species of timber (based on quality) and the seriousness they attach to timber harvesting fees or payments. Table 3 presents a summary overview of the indicated amounts and Table 4 provides further details about the variation in these amounts.

The minimum and maximum amounts offered for high quality trees were Gh¢ 5/tree and Gh¢ 300/tree respectively, with a mean amount of Gh¢

33.90 (USD 24)/tree. Similarly, the average amount the operators were willing to pay for medium quality trees was Gh¢ 17.72 (USD 12.7)/tree, with a minimum and maximum amounts of Gh¢ 4/tree and Gh¢ 150/tree respectively. For low quality trees, the minimum and maximum amounts offered were Gh¢ 2/tree and Gh¢ 50/tree, with a mean of Gh¢ 9.43 (USD 6.7)/tree.

As indicated by the difference between minimum and maximum values, there is a large variation in willingness to pay. For high quality trees, 26% of the respondents were willing to pay Gh¢ 20/tree, 16% were willing to pay Gh¢ 10/tree, 14% offered Gh¢ 50/tree, while 2% offered Gh¢ 300/tree. Eighteen percent of the respondents were not sure and so could not elicit any amount. Likewise, for medium quality trees, 24% of the respondents stated Gh¢ 10/tree, 18% offered Gh¢ 20/tree, while 14% could not state any amount. For low quality trees, 18% of the respondents stated Gh¢ 10/tree, another 18% offered Gh¢ 5/tree, while as much as 32% indicated that they were not sure (Table 4).

Table 3: Descriptive statistics of the amount chainsaw operators are willing to pay for different categories of trees

Type of tree (in terms of quality)	N	Minimum amount (Gh¢/tree)*	Maximum amount (Gh¢/tree)*	Mean amount (Gh¢/tree)*	Std. Error of the mean	Std. Deviation
High quality species	41	5	300	33.90	7.29	46.684
Medium quality species	43	4	150	17.72	3.47	22.742
Low quality species	34	2	50	9.43	1.56	9.097

*At the time of the study, US\$ 1 was equivalent to Gh¢1.4

Table 4: Proportion of operators and the indicated amounts they are willing to pay for different categories of trees

Amount willing to pay (Gh ¢/tree)	High quality trees		Medium quality trees		Low quality trees	
	No. of respondents	% of respondents	No. of respondents	% of respondents	No. of respondents	% of respondents
2.00	0	0	0	0	3	6
3.00	0	0	0	0	4	8
4.00	0	0	1	2	2	4
5.00	3	6	8	16	9	18
6.00	0	0	1	2	0	0
7.00	0	0	1	2	0	0
10.00	8	16	12	24	9	18
15.00	1	2	4	8	2	4
20.00	13	26	9	18	4	8
25.00	0	0	1	2	0	0
30.00	1	2	4	8	0	0
40.00	6	12	0	0	0	0
50.00	7	14	1	2	1	2
100.00	1	2	0	0	0	0
150.00	0	0	1	2	0	0
300.00	1	2	0	0	0	0
Not sure	9	18	7	14	16	32
Total	50	100	50	100	50	100

These willingness to pay values elicited by the chainsaw operators are indicative of the value they place on timber resources. As has already been mentioned, willingness to pay refers to the maximum amount individuals are willing to pay for a good or service. In general, the more a person values a good, the greater is his willingness to pay for that good (Field, 2001). People's willingness to pay is important because consumer responses to prices influence commodity utilisation levels and patterns, and revenues collected therefrom. For instance, the efficiency and equity impacts of prices for timber resources will be influenced by individuals' willingness and ability to pay (Pearce and Turner, 1990).

A comparison of the values elicited by the operators with stumpage fees indicates that the average price that operators were willing to pay for high-quality timber compares favourably with the stumpage fee currently paid by licensed loggers of US\$7.5/m³ (or \$22.5/tree). The operators were willing to pay approximately 6 percent more than the official stumpage value (Table 5). This observation indicates the potential increase of forest revenue to the state through taxation of chainsaw millers in case that they would be allowed to operate under a legalized regime.

Table 5 Comparison of operators' willingness to pay with official stumpage

Category of tree	Average Willingness to pay (GH¢/tree)	Comparison of average willingness to pay with stumpage of US\$7.5/m ³ (or \$22.5/tree) ²
High quality trees	33.9 (\$24) ¹	6 percent more
Medium quality trees	17.7 (\$13)	65 percent less
Low quality trees	9.4 (\$7)	69 percent less

¹Based on exchange rate of \$1 to GH¢ 1.4

²Stumpage adapted from Marfo (2009)

Timber Harvest Right or Permit Preferred by Chainsaw Operators

The respondents identified several forms in which the timber harvest right/licence/permit could take should their activities be regularized. The majority (74%) reported that they prefer concessions for registered groups of operators, 18% were in favour of individual permits to harvest individual trees (permit per tree harvested), while 6% preferred

small concessions for individual operators. One of them was of the view that chainsaw operators should be attached to existing Timber Utilization Contract (TUC) holders (Table 6).

It does seem from the above that most operators are in favour of any system that allows for organized groups. This arrangement holds some appeal since it may facilitate effective monitoring of the activities of operators.

Table 6 Forms of timber harvest right/license/permit identified by chainsaw operators

Form of timber harvest right/permit	Number of respondents	Percentage of respondents
Chainsaw operators should be attached to an existing TUC holder	1	2
Small concessions for individual operators	3	6
Concessions for registered groups of operators	37	74
Individual permits to harvest individual trees (permit per tree harvest)	9	18
Total	50	100

CONCLUSIONS

The majority of chainsaw operators perceive the availability of timber resources to be declining due partly to unregulated harvesting by both chainsaw operators and conventional logging operations. Notwithstanding the ban on chainsaw milling, the activity continues to be a major supplier of lumber to the domestic market and helps to sustain rural economies and livelihoods. It is estimated that chainsaw milling consumes over eight hundred thousand trees per year, providing approximately a million cubic metres of lumber to the domestic market (Marfo, 2009). Chainsaw operators do not currently pay stumpage fee or other official taxes or levies for trees they harvest due to the absence of a legal framework for this work. This leads to loss of revenue to the state. This study shows that chainsaw operators are willing to pay the FC for timber harvesting rights if their activities are captured under a regularized regime and the necessary legal framework put in place to encourage them to do so.

The regularization of chainsaw milling may not only contribute towards further government revenue earning, but may also contribute towards improving local livelihoods. The present ban on chainsaw milling has a tremendous impact on local communities and the resources on which their livelihoods depend. The operators and their crew often work undercover and show little sense of responsibility and care towards the resource. The ban threatens rural livelihoods (Parren *et al.*, 2007), undermines the sustainable management of forest and timber resources and is a strong disincentive to local management of forests. It stifles the evolution of local institutions that protect forest resources and promotes a feeling of animosity between local communities and the Forestry Commission (FC) as well as law enforcement agencies. The ban has led to some operators losing their lives in the process of engaging in chainsaw lumbering. In addition, the

ban heightens corruption in the forest sector (Adam *et al.*, 2007b) and, as has already been said, leads to loss of revenue to the government and all beneficiaries of timber royalties (Parren *et al.*, 2007). It leads to the destruction of valuable ecosystems since it promotes "race to harvest", and as operators often engage in illicit and profligate harvesting of trees. Indeed, Brown (1999) cautioned against the ban as far back as 1999 and reported that "the Forestry Department (now the FSD) is seeking to impose a complete ban on chainsaw logging in the informal sector, despite the effects that this is likely to have on rural livelihoods" (Brown, 1999:15).

Rather than continuing with a ban which has not been effective in addressing indiscriminate logging, chainsaw operations need to be regularized and integrated into mainstream forest management and operations. Legalization and regularization of chainsaw milling activities will gain the support of local communities, chainsaw operators, farmers, timber dealers, carpenters, building contractors, individual builders, and a host of people who depend on chainsaw milling for lumber. The ban needs to be reviewed to ensure that chainsaw operators pay appropriate taxes to the state for the trees they fell. Several feasible tax regimes may be applied to chainsaw enterprises. However, product taxes, income taxes and monthly or annual permit fees seem to appeal to operators. One key challenge, however, is how to effectively monitor the activities of operators due to their informal organization, their lack of record keeping, and the clandestine nature of their activities. Thus, care must be taken to address the underlying organizational and monitoring capacity issues before such a reform is implemented.

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