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Exploring Species Extraction Volume and Residues of Illegal and Conventional Logging Operations

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Governments, policymakers, at most public fora, condemn activities of chainsaw operations as illegal and in fact, it has been criminalized with an explanation that it is wasteful and destructive to the environment. The study compared species, diameter distribution, extracted, volume, and residues generated during conventional and illegal logging operations in the forest communities. Using quantitative design approach, the researchers estimated the volume of waste generated by illegal logging and that of conventional loggers and also identified the species targeted. In order to determine the diameter distribution of exploited species, and the recovery rate of logs in both reserves, the researchers measured both ends, diameter, and length of stump wood and merchantable branch wood left as waste using the smallian's formula. The total volume of logs

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utilized per tree (logvol) was then calculated as the sum of the volume of each log. Twenty-five commercial timber species were identified to have been felled on farmlands compared to 34 commercial species which were felled in the TBFR. On both the farmlands and in the TBFR, the number of species felled by chainsaw operators far exceeded those felled by the conventional loggers. On farmlands, only four (17%) out of the 25 timber species were felled by conventional loggers. The most dominant timber species felled by the conventional loggers on farmlands was ceiba which comprised more than half (53%) of the total trees felled, followed by yaya (32%), watapuo (Cola gigantea), and akasaa (Chrysophyllum albidum). The study concluded that not only do chainsaw operators target a variety of lumber species but they also exploit timber species that are near extinction, therefore, making their activities pose danger to species diversity and conservation. The study proposed that strengthening the policy regime on compensation payment could help reduce the Incidence of illegal logging.

Keywords: Chainsaw operations; compensation; community identity; livelihood support; environment.

1. INTRODUCTION

The total forest area of Ghana stands at 5.5 million representing about 24% of total land area. According to F.A.O [1], the annual rate of decline of the forest area of Ghana stood at 135.000 hectares for the period between 1990 and 2000 and 115,000 hectares from 2000 and 2005, and between 1990 and 2005, the forest area of Ghana experienced an annual decline rate of 2%. What is more disturbing is the eminent extinction of commercial timber species. Ghana's forest originally covered about 36% of the total land area of the country which was also undisturbed (Alpert, 1993; FAO 1999) [2]. It is estimated that timber demand in Ghana is about 3.2 million per year and the annual allowable cut (A.A.C.) has been 1.0 million m3 per year leaving a shortage of 2.2 million [3]. Although forest plays a vital role in Ghana's economy and a great number of people depend on its resources for subsistence and to satisfy their socio-economic needs, the challenge faced by the country today is the need to reconcile demand and supply of the resources to meet economic needs of the people [4]. Amoah and Becker [5], indicate that an average merchantable logging recovery in Ghana is about 75%, implying that 25% of these logs are left in the forest unutilized. Logging efficiency in Ghana has been reported to be as low as 50% [6]. Governments, and policymakers at most public fora, have condemned the activities of chainsaw operations as illegal and in fact, it has been criminalized with an explanation that it is wasteful and destructive to the environment. With the ban on this illegal trade, the practice is still in ascendency [7]. A study conducted by Obiri et al. [8], suggests that farmers knew the C. S. M that operates on their farms yet they refused to own them out. Odoom, [9] also confirms that farmers gain nothing when they cooperate with forest officials to arrest their own people and in fact connive with illegal chainsaw loggers to benefit from a share of the resources, Frimpong [10], reported that chainsaw operations employ over two thousand (2000) youth from the communities where they operate compare with little above one thousand (1000) by timber firms. Of all the studies on chainsaw activities, what we have not captured has been the main driving force behind this activity is sociological connotations between the operators and the members of the communities of which the operators are also part of them. Again, little is known about species targeted by these operators. The study further seeks to compare the species, diameter distribution, extracted, volume, and residues generated during conventional and illegal logging operations in the forest communities. In view of these, the following theoretical framework was designed for these assessments. And Sekondi-Takoradi as a case study.

2. PREVIOUS RESEARCH

2.1 Meeting Local Demand for Sawn Timber

In the late 1980s and throughout the 1990s, government's attempt to supply the local market with lumber was mainly through the imposition of levies on sawn timber with the aim of reducing its export and hence making it more available for the domestic market [11]. In practice, this approach did not work because the exporters could still make more in the international market and also because of the need for foreign exchange to meet their capital equipment [11]. According to Sarfo [12], permit was granted by

forestry department to register chainsaw operators and traders of wood products to fell and sawn timber at off reserves for sale to the local market. It was observed that this practice was cheaper and could meet the needs of the local market. However, this was canceled following abuse by these groups and connivance with forestry officials. Currently, the Ministry of land through the forestry commission has designated some formal timber processing firms to supply the local market with about 20% of their total output to the local market [13]. The report by (TIDD) further indicated that the supply from these sources is either too expensive or out of reach of the ordinary individual who is building his home. Furthermore, between January and July 2004, it was estimated that a total of 4,738.8m3 and 4,374m3 were supplied by the selected firms which represent about 10% of the lumber and other wood products sold on the local market [13] These findings were confirmed by Gayfer et al. [12] that two-thirds of the wood harvested in (1999) in the country was done illegally and this was focused in off— reserve areas and is dominated by the activities of illegal small scale chainsaw operators. The mention of restrictive forest and tree tenure arrangement and the ban on chainsaw milling is limiting access to timber tree in particularly, operations continue and are currently reported by FSD to be on increase [9]. The continuation and expansion of "illegal chainsaw milling in Ghana are in part due to lack of clarity over forest tree and farm tree ownership [14,9] (Marfo, 2004). A survey conducted by TIDD/FORIG in 2009 revealed that 84% of lumber processed was for the domestic market out of these, 16% came from conventional sawmills [7,13].

2.2 Conversion Efficiencies of Ghana's Lumber

Effective and efficient management and proper utilization of forest resources can be used to predict and control the flow of wood volume as a way to minimize wood losses and maximize merchantable volume [15]. According to Adam and Dua-Gyamfi (2009), chainsaw lumber is 12-74% cheaper than sawmilled lumber from the same tree species, quality, and dimensions, and the range of species and dimensions it offers-, is much larger (Adam and Dua-Gyamfi 2009) [16]. Conversion efficiencies for C.S.M range from 27-40% according to Marfo [17], the annual volume ranges from 2.2 to 2.9 million m3 which is also equivalent to about 74000 to 970,000 trees per year, this means that the country's AAC is under treat [17]. In spite of being banned in 1998, chainsaw milling continues to be a major supplier of Ghana's domestic lumber needs [18]. Much of the domestic supply of lumber is derived from "illegal" chainsaw milling. For example, the Wood Industry and Log Ban Study (WILBS) conducted in 1999, indicated that out of the 3.7 million of timber harvested, illegal chainsaw activities accounted for 46 percent. (i.e. 1.7 million m3), whiles legal industrial logging accounted for a further 24 percent or 0.9 million n/ [3]. In Ghana, logging efficiency is reported as low as 50% [6]. Further studies conducted by Amoah and Becker [5] estimated a 75% merchantable lumber recovery in Ghana. This means that 25% of timber is said to be waste. In that report, branch wood up to 20cm in diameter was calculated. As Day (1998), reported, the instrument used in estimating the volume of timber does not encourage loggers to practice logging efficiency. All these have been accredited to legal logging. It is often reported that illegal chainsaw milling is wasteful and from all indications, we have not been able to combat this illegal trade because we have not yet answered the question; Do socialization, social identity, and cooperate responsibility theories matter? However, to date, the volume of waste generated by illegal logging is yet to be estimated. Again no substantial study has been conducted on species targeted by illegal chainsaw operators. Furthermore, why illegal loggers enjoy support from community members is yet to be found. It is in line with these that the researcher wants to compare the activities of illegal logging and that of conventional logging.

3. RESEARCH METHOD

The data was collected in two forest zone. Tinte Bepo Forest Reserve (TBFR), and Off Reserves areas where commercial species are located. Quantitative research design was employed for the study. In the quantitative design, the researchers wanted to estimate the volume of waste generated by illegal logging and that of conventional loggers and also to identify species they target. In order to determine the diameter distribution of exploited species, and the recovery rate of logs in both reserves, the researchers measured both ends, diameter and length of stump wood and merchantable branch wood left as waste using smallian's formula [19,20]. The total volume of logs utilized per tree (logvol) was then calculated as the sum of volume of each log. Log Vol = where V is the volume of each log and N is the number of logs

in each tree. The volume of all branches as low as lcm diameter upwards was estimated to get the total volume of residues using Smallian's formula [19], to determine the quantity of residue generated in both reserves. The same method was used to calculate for other branches from 30cm and above to 5cm and below in order to get the total volume of a tree, the stump wood was also calculated. In all, a total of three hundred and ninety-four (394) timber species were sampled. Out of these, one hundred and twenty (120) were converted legally and the remaining two hundred and seventy-four (274) were also harvested illegally. The objective of this is to determine the quantities of logs utilized and those that are lifted as residues. The convenience sampling method was used because the trees that were felled, due to the landscape, some of the trees felled in valleys were very difficult to have accessibility. Again, considering time and resources available, convenience method was preferable [21].

4. RESULTS AND DISCUSSION

4.1 Estimation of Utilized Log and Residues

The number of commercial timber species exploited by conventional loggers and chainsaw operators on farmlands and in the Tinte Bepo Forest Reserve (TBFR) is reported in Figs. 2 and 3, respectively. Twenty-five commercial timber species were identified to have been felled on farmlands compared to 34 commercial species which were felled in the TBFR. On both the farmlands and in the TBFR, the number of species felled by chainsaw operators far exceeded those felled by the conventional loggers. On the farmlands, only four (17%) out of the 25 timber species were felled by conventional loggers. A similar pattern was observed in the forest reserve. Out of a total of 34 timber species felled, half (50%) were felled by conventional loggers while all 34 timber species were exploited by chainsaw operators. The most dominant timber species felled by the conventional loggers on farmlands was ceiba which comprised more than half (53%) of the total trees felled, followed by yaya (32%), watapuo (*Cola gigantea*), and akasaa (*Chrysophyllum albidum*). Among the timber species felled by chainsaw operators on farmlands, six of them were restricted species. This represented about 26% of the trees felled by chainsaw operators. In the TBFR, 18% of commercial timber trees felled by chainsaw operators were restricted species compared to 19% of timber from restricted species felled by conventional loggers. In total, every one out of five (20%) trees felled by chainsaw operators was restricted timber while 14% of the trees felled by the conventional loggers were also restricted species. Thus, not only do chainsaw operators target a variety of timber species but they also exploit timber species that are near extinction therefore, making their activities posing danger to species diversity and conservation.

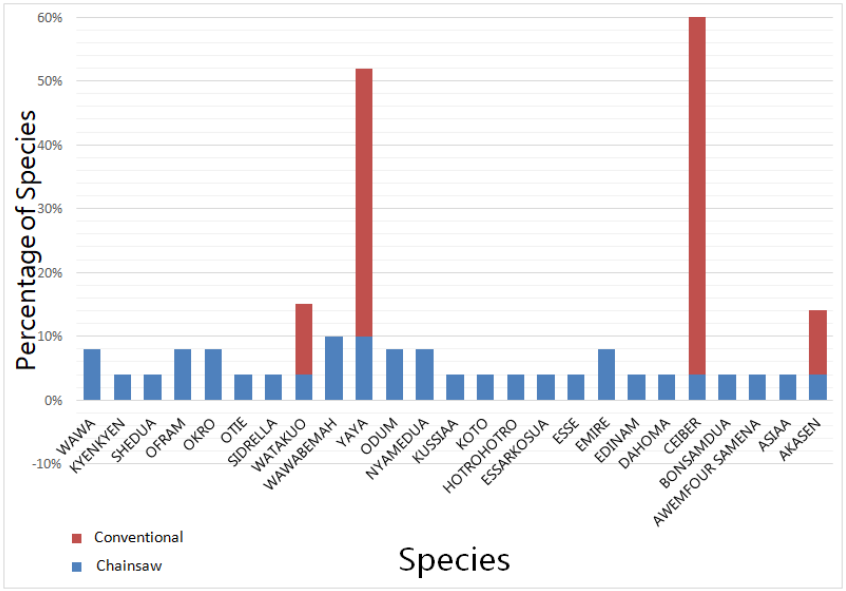

Fig. 1. Vegetation type: Farmland

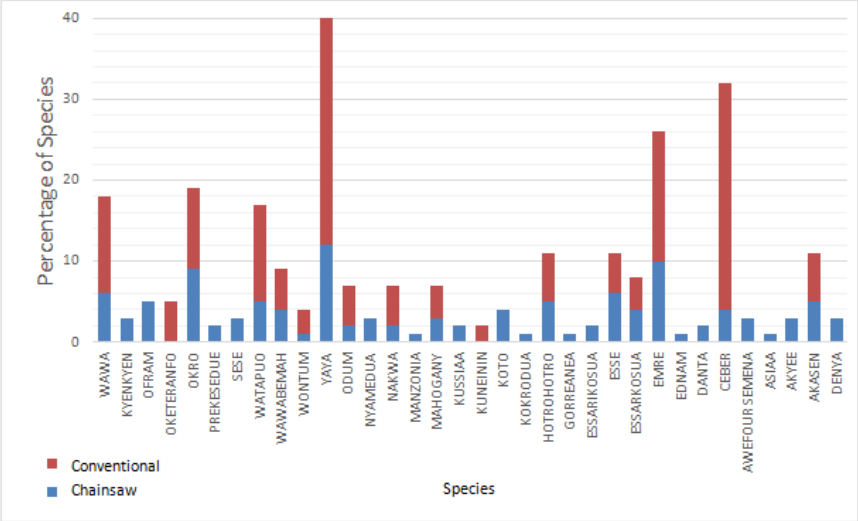

Fig. 2. Vegetation type: Forest

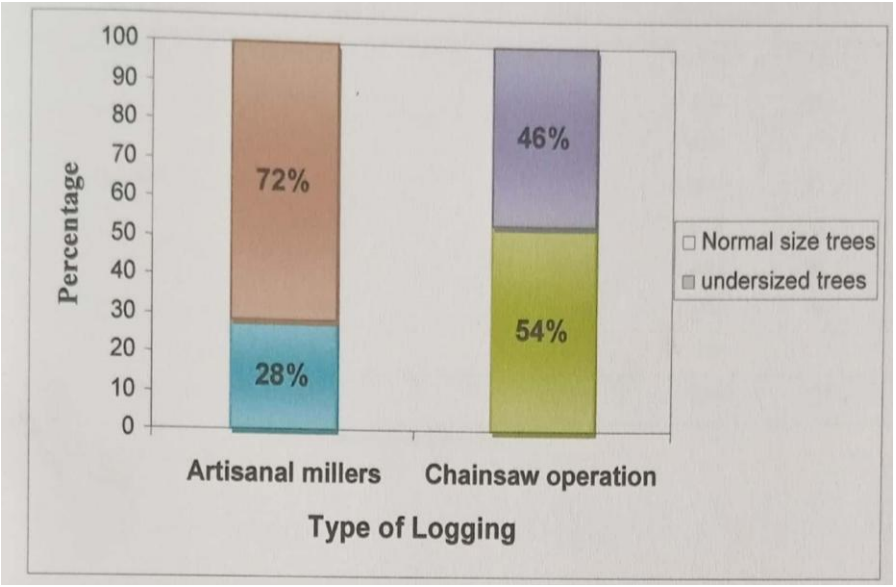

Fig. 3. Shows percentage of timber felled underside

Fig. 2 compares the percentages of timber species felled by conventional loggers and chainsaw operators on farmlands on adhesion to felling limit of species.

It was observed that not only chainsaw operators felled undersized timber species but conventional loggers are equally victims. Species felled by chainsaw operators on farmlands, six of them were restricted species. This was observed that not only chainsaw operators felled undersized timber species but conventional loggers are equally victims. Species felled by chainsaw operators on farmlands, six of them were restricted species. This represented about 26% of all trees felled by chainsaw operators. In the TBFR, 18% of the commercial timber trees felled by chainsaw operators were restricted species compared to 19% timber trees from restricted species felled by conventional loggers. In total, every one out of five (20%) trees felled by the chainsaw operators was a restricted timber species while 14% of the trees felled by the conventional loggers were also restricted species. Thus, not only the chainsaw operators target the varieties of timber species but they also exploit timber species that are near extinction, therefore, making their activities

pose danger to species diversity and conservation.

Fig. 3 compares the adhesion of felling diameter of both conversional loggers and chainsaw millers. It must be emphasized from the study that both chainsaw operators and the artisanal millers illegally cut trees undersize. The study reported that conversional loggers felled 28% undersize timber compared with 54% done by Chainsaw operators and 72% normal converted by Conversional loggers as against 46% converted by illegal Chainsaw operators. The success chalked by Conversional loggers may be due to the fact that knowing that forest inspectors will check them at the weighing point, they tried to adhere to felling limit prescribed by Forest Commission compare with illegal Chainsaw operations whereby little or no checks are done. Thus both chainsaw millers and conventional millers are all victims when it comes to felling undersize timber.

Table 2 compares log recovery rates in farmland and forest reserve. The log recovery for both conventional loggers and that of illegal loggers was reported in Tables 1' and 2 respectively. Table 1 seems to suggest that there is no significant difference between logs fallen by conventional loggers in terms of recovery rate at 70.9% compared to illegal operators that were able to retrieve 66.2%. This goes to suggest that, in terms of wastage, whiles conventional millers generate 29%, illegal chainsaw operators also generate 33.8%.

However, when the study was pushed to vegetation type, to assess the recovery rate in both farmlands and forest reserves, there seems to have a significant effect on log recovery rate. In the forest reserved 65.3%, of lumber was recovered compared to farmlands where 75.20/o were recovered with an F value 9.395 and P-value of 0.002. The study could not support the notion that illegal chainsaw operations are wasteful in terms of log recovery.

Table 1. Log recovery rate in farmlands and forest reserves

Descriptive Statistics

Dependent Variable: Vlogutilisedpereent

Vegetation type	logging type	Means	Std. deviation	N
Forest	illegal	63.781	16.1875	125
	Legal	69.174	20.1722	48
	Total	65.277	17.4919	173
Farmland	illegal	74.751	11.8427	35
	Legal	76.334	19.5796	15
	Total	75.226	14.4008	50
Total	illegal	66.180	15.9700	160
	Legal	70.878	20.1118	63
	Total	67.508	17.3241	223

Tests Of Between – Subjects Effects

Table 2. Log recovery rate for illegal and conventional millers

Source	Type III sum of squares	df	Means square	f	sig.
Corrected model	4874.274*	3	1624.758	5.762	.001
Intercept	650253.730	1	650253.730	2.306E3	.000
Vegetation type	2649.300	1	2649.300	9.395	.002
Logging type	392.253	1	392.253	1.391	.240
Vegetation type *logging type	117.001	1	117.001	.415	.520
Error	61753.071	219	281.9777		
Total	1082898.154	223			
Corrected total	66627.345	222			

a. R Squared = .073 (Adjusted R squared = .060)

Plate 1. Shows Researcher taking measurements of waste timber

Plate 2. Shows the Researcher taking measurements on waste timber

Plate 3. Shows an agent observing an operation in the forest

Plate 4. Shows Waste Timber left in the forest by illegal operators

5. CONCLUSION

The study revealed that both illegal and conventional loggers felled restricted timber species, thereby violating forestry commission laws on restricted timber. Again, both loggers floated rules on undersized timber with chainsaw operators being the most offenders with 54% as against conventional 26%. The most dominant species targeted by conventional loggers on farmland include Ceiba (*Ceiba pentandra*) Yaya (*Amphimas pterocarpoides*) Watapuo (*cola gigantea*) and Akasaa (*Chrysophyllum albidum*). On log recovery rate, the result shows that there was significant difference in the log recovery rates between chainsaw and conventional logging operations. Whiles chainsaw recorded 66%, conventional, loggers recorded 71%. This means that illegal loggers generate 44% of waste as compared to 29% by conventional loggers. The reason is that chain saw operator cut all varieties of all spices as compared to the conventional that target specifics pieces. Again upon hearing the forest guard comes they away living the felled log unprocessed. More so, conventional loggers cut to the first branch whiles chainsaw operators will cut to meet their convenience. The paper concludes that that there was a great significant recovery rate between illegal millers and of conventional millers. Again both millers were seen to cut undersize and prohibited both in the forest and off-forest reserves [22-27].

6. RECOMMENDATIONS

1. It was recommended that more people should be employed and trained in Forestry Department to control and regulates the activities of all milling operations.
2. Again logistics like vehicles and arms should be given to these men and be trained on how to use weapon as most of the illegal chainsaw operators armed them in their operation site.
3. The chainsaw operators should be educated on their activities to reduce wastage and to embark on reforestation drive.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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