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LIST OF ACRONYMS

ACMLI	Around-the-Clock Monitoring of Lumber Inflows
CSIR	Council for Scientific and Industrial Research
EU	European Union
FC	Forestry Commission
FORIG	Forestry Research Institute of Ghana
IELVS	Inquisitive Estimates of Lumber Volume Supply
LI	Legislative Instrument
SP	Salvage Permit
TBI	Tropenbos International
VPA	Voluntary Partnership Agreement
TUC	Timber Utilization Contract
TUP	Timber Utilization Permits
FLEGT	Forest Law Enforcement, Governance and Trade
RWE	Round Wood Equivalent

1 INTRODUCTION

Chainsaw lumbering may be defined as the stump side production of lumber with the use of chainsaw (Adam *et al*., 2007). The practice, although outlawed since 1998, is widespread in Ghana (Adam *et al.*, 2006; Agyeman *et al*., 2003; Birikorang *et al.*, 2001a; Fobih, 2003; Odoom, 2005). According to Adam et *al*. (2007) pieces of chainsaw lumber are transported from the stump sites, where milling takes place, to domestic marketing centers. The carting of the lumber, the report continues, is mainly done with haulage trucks with capacities ranging between 20 and 35 m^3. Most of the domestic demand for lumber as well as part of the demand of neighbouring countries is met by chainsaw operators, who convert trees into lumber (Odoom, 2004). Therefore the marketing unit of the chainsaw lumber enterprise, which is organized in specific locations in all the capital towns in the 138 districts in the 10 regions of Ghana (over 44 domestic timber markets), is very important to be considered in policy decisions (Damnyag and Obiri, 2009; Obiri *et al*., 2009). The report adds that the unorthodox means by which chainsaw lumber pieces are conveyed to the market centers include concealment of lumber in vehicles carrying goods like food stuffs and charcoal to the local markets. Damnyag and Obiri (2009) have reported that carting of lumber to the various domestic markets is facilitated by "road masters" on the highways. According to the report it has become possible due to the establishment of good working relationship between them and the security/task force that is responsible for the control of movement of lumber on the roads. Therefore the rate of seizure of chainsaw lumber and the monies paid to get them to the timber market or consumers have reduced. Chainsaw lumbering has been reported by Marfo and Azu (2009) to be the major source of lumber supply to the domestic market that satisfies the timber needs of the local communities. The report continues that estimated employment levels in the enterprise ranged between 77,500 and 92,000.

Various measures have been tried to discourage chainsaw lumbering activity that supply lumber to the domestic market. These include the Trees and Timber (Chain-saw Operations) Regulation, 1991 (LI 1518); Development of First Police Task Force in 1966 to monitor illegal chainsaw activities, followed by Military Task Force; Prohibition of chainsaw operations under the Timber Resource Management Act, 1997 (Act 547); Prohibition of the use of unregistered chainsaw, chainsaw milling and selling of chainsawn lumber

under the Timber Resource Management Regulations, 1998 (LI 1649), Sec 32(1 &2) (Agyeman, *et al*., 2004; Parren *et al*., 2007).

Despite these measures that have been reported by Agyeman, *et al*. (2004) and Parren *et al*. (2007), the success rate of the ban on chainsaw lumbering has however been meager, and the trade in chainsaw lumber appears to be increasing. This is because most of the sawmills did not have the Timber Utilization Contract (TUC), Timber Utilization Permit (TUP) or Salvage Permit (SP) areas to operate, hence they were compelled to buy their logs from local suppliers (Parren *et al*., 2007). In this case they could not even be restricted to sell their lumber on the domestic market. The report continues that there was no compulsion on the few sawmills who won the TUC bid to supply 20% of their total lumber production to the domestic market as stated in Regulation 36 of LI 1649. This is because the bid price was too high for them in addition to the payment of the Timber Right Fees (TRFs) and other statutory charges. Again, some timber exporters had acquired export free zone status and ten-year tax holidays under the Free Zone Act, 1995 (Act 504) including the foreign exchange retention allowances under the Ghana Investment Promotion Act, 1994 (Act 478). Such sawmills were also not allowed by the Free Zone Act to supply beyond 30% of their output to the domestic market (Parren *et al*., 2007).

On the other hand, some factors that are promoting chainsaw lumber supply into the domestic market include high demand for lumber, low prices of chainsaw lumber, comparatively more suitable for local applications, scarcity of sawmill lumber on the domestic market with respect to the preferred timber species and their quality and quantities, corruption, low investment cost of chainsaw operational facilities and increased livelihood opportunities for the rural poor (Agyeman, *et al*., 2003; Fehr and Pasiecznik, 2006; Obiri and Damnyag, 2009; Odum, 2005; Sarfo-Mensah, 2005). Others that have been reported by Abroquah (2004) and Owusu (2004) include inadequate capacity of the Task Forces to monitor the many road corridors leading to the regions, Task Forces poorly remunerated and inadequately resourced, penalties prescribed for forest offences under section 17 of Act 547 and regulation 41 of LI 1649, are conflicting and not deterrent enough to discourage aggressive illegal chainsaw operators of the forest resource and the inability of the Task Force to enter the domestic lumber market to make arrests of illegal operators for prosecution.

To be able to devise appropriate policy measures it is very important to have an in-depth understanding of the chainsaw lumber business, the economic drivers, the agents (stakeholders) in the business and the interactions between them. Reliable information on the size of the market is a basic requirement for forest policy interventions. In this regard it is crucial for the discussions and actions under the Ghana-EU Voluntary Partnership Agreement (VPA) under the EU Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan.

A number of studies have looked into the supply of chainsaw lumber into the domestic timber market to estimate the annual inflows to enable policy makers know the trend of supply. These include an estimate made by Birikorang *et al.* (2001a). They estimated the total timber harvest to be 3.7 million m^3 as Round Wood Equivalent (RWE) for 1999. This was divided into 2.0 million m^3 RWE consumed by the formal wood industry producing approximately 0.8 million m^3 of products of which half was exported and the other half placed on the domestic market, including 200 000 m^3 of lumber (Hansen *et al.*, 2012). The remaining 1.7 million m^3 RWE, according to the report, is processed by chainsaw operators, producing approximately 460 000 m^3 of lumber, which is all traded in the domestic market. This has been interpreted by Hansen *et al.* (2012) to mean that approximately 860 000 m^3 out of a total production of 1,260 000 m^3 (68%) is traded in the domestic market, of which 660 000 m^3 (77%) is classified as lumber. The results of the study, as reported by Hansen *et al.* (2012) were based on a questionnaire survey whereby questionnaires were administered to 111 respondents. These included logging operators, wood processers, furniture and woodworking companies, local timber market wholesalers and retailers. Comparison of this approach to that recorded in Birikorang *et al.* (2001b), shows a weakness in the specific methods that were used for the study, for instance the applied sampling frame and the study does not concern the share of sales for overland export in the domestic market (Hansen et al., 2012). Nonetheless, the results have been widely quoted by virtue of being the first study on the subject. In another study undertaken in 2005 to update the earlier results, Hansen *et al.* (2007) have reported that additional interviews and data analysis approach were used hence making the documentation of the applied methods wanting.

Obiri *et al.* (2009) studied the domestic market in Ghana through an interview survey involving 611 timber merchants/dealers and consumers in 44 timber markets throughout Ghana. According to the report, the surveyed markets provided for over 70% of the domestic market, but no justification was given to support their assumptions. In each market, a representative number of

respondents were sampled for interviewing, which was based on the size of the market (large , medium and small) or the number of selling points with sellers present on the market at the time of the visit. Therefore in a large market where dealers in sheds or selling points exceeded 500, the sample size was 5%. In a medium market (dealers between 100 and 500) 10% of population was sampled, while markets with less than 100 dealers (those in sheds and selling point) the sampling intensity varied between 20 and 100% (Obiri *et al.* 2009). Marfo (2010) combines the results of Obiri *et al.* (2009) with the estimate of Blackett and Gardette (2008) on overland wood export. The average chainsaw lumber production estimated was 760,000 m^3 or 2.5 million m^3 RWE. Meanwhile the methodology for the estimate made by Blackett and Gardette (2008) was not described. Again, a study by Chatham House (2010) estimates the domestic consumption (both sawmill and chainsaw products) in Ghana to be 3.1 million m^3 RWE. The approach to the results and the proportions of sawmill and chainsaw products are not specified. These concerns were expressed by Hansen *et al*. (2012).

A study by Hansen *et al*. (2012) on the assessment of the size of 19 lumber markets in Ghana was based on monitoring of vehicles carrying lumber to the markets. They assessed the volume of wood traded in the selected domestic markets through direct observations of identified vehicles transporting lumber to the markets over a two week period during the dry season (peak season) and rainy season (low season). The methodology was pre-tested at Anloga timber market in Kumasi during which the various types of vehicles that were being used for lumber transport were identified. A team of two trained enumerators and employees of the lumber dealers at each market was placed at strategic positions within the markets or at entry gates. They recorded the date, time, type of vehicle and lumber supply source for each vehicle entering their market and worked in 12-hour shifts, hence Around-the-Clock Monitoring of Lumber Inflows (ACMLI). They also interviewed a number of the timber dealers at the various markets for information on the lumber load of vehicles, which included the typical number of pieces of lumber and their dimensions for each vehicle type. Estimations for the monthly mean, low and high volumes of lumber for the relevant vehicle types and summation were made from which the annual volume of lumber supply estimate was established. Finally, Hansen *et al*. (2012) estimated that chainsaw production to the domestic market could be in the range of 539,704 m^3 and 1,106,154 m^3 (1.8 – 3.6 million cubic meters in RWE).

1.1 Problem identification

From the earlier studies as stated above, two basic methodologies have been used in estimating the volumes of lumber supply to the market centers in Ghana. The results from these methodologies have yielded different estimates of annual lumber supply to the domestic market. This undermines policy efforts as policy actors and scholars are confronted with conflicting data. Again, there is difficulty in selecting an appropriate methodology for future study of the supply of lumber (sawmill and chainsaw) to the domestic market. Hansen *et al*. (2012), argue for an improved approach thus claiming methodological superiority. However, the annual lumber volume supply estimate seems to be comparatively too high by forestry analysts (Marfo, personal communication). Therefore, for policy actors and scholars to be able to rely on the latter methodology and hence the estimates, there is the need to validate the approach and to identify any inherent weaknesses and or challenges.

The methodology by Hansen *et al*. (2012) used the bucket volumes of the various vehicle types identified (as given by the market timber dealers) to determine the volumes of lumber that entered the markets. This could be problematic as it may lead to under – or over – estimation. The reasons are that, taking cognizance of the chainsaw timber operations, firstly, different dimensions of lumber or a mixture loaded in the same container or bucket of a particular vehicle will give different volumes. Secondly, lumber pieces at a particular milled site are made up of different dimensions, hence a particular vehicle type, for instance every Kia Rhino, will not be loaded with the same lumber dimensions to justify the claimed by the timber dealers that the quantity of 2x6x14 lumber loaded in such vehicles will be between 400 and 450, Thirdly, a number of Kia Rhinos loaded with different timber species but of the same lumber dimensions will not have the same quantities or volume, Fourthly, the loads of vehicles are dependent on the distance between chainsaw milling site and the market . Fifthly, the estimated bucket quantities (volume) per dimensions of lumber per vehicle type that entered the market, which was used in estimating the lumber volumes, could also be under/over estimated as some of the buckets may be under or over loaded.

1.2 **Objective of the study**

Due to the inherent possibilities of under and over estimation based on the approach of Hansen *et al* (2012), there was the need to validate the parameter of vehicle estimation and if possible suggest an adjustment.

2 METHODOLOGY

Owing to limited time, only three (3) major timber markets studied by Hansen *et al.* (2012) were selected for this study. These were the three markets where the largest volumes of chainsaw lumber were supplied during the peak period of their study. These included Muus timber market in Accra (Greater Accra region), Sokoban (used to be Anloga) timber market in Kumasi (Ashanti region) and Techiman timber market near Sunyani (Brong Ahafo region). The timber enumerators from Hansen *et al.* (2012) were also identified and interviewed with structured questionnaire (Appendix 1). The main aim was to gather information on some challenges that the earlier study might have encountered and also to find out if they could be registered as enumerators for the validation study. Based on the interviews with these former enumerators the methodology and the form for the data collection (Appendix 2) were slightly modified. The enumerators were trained on the data collection forms, identification of vehicles loaded with lumber and assessment of the contents of vehicles (determination of the quantities of lumber per vehicle type per specific dimensions, type of species and random measurement of lumber using steel tape). This was to make it easier, with the help of Excel spreadsheet, to determine the volumes of the different lumber dimensions to be identified per vehicle type. Enumerators were expected to trace each vehicle to where it would be off-loaded in order to identify the actual dimensions of lumber and have them counted on the basis of lumber dimensions when and where necessary. This was possible because the enumerators were the employees of some of the timber dealers and hence were known in the markets that were assigned to them. Due to the sensitivity of the study, as was done by Hansen *et al.* (2012), the idea was for the enumerators to attract as little attention as possible, therefore no attempt was made to inform the market associations or other agents about the research. However enumerators were informed by the research team from the CSIR-Forestry Institute of Ghana (FORIG) the purpose for which the research was being conducted. At each of the three timber markets, the CSIR-FORIG research team and the enumerators combined to undertake a one day joint enumeration. Additional data verification was conducted through informal discussions with a number of dealers who willingly provided information on the loads of the various vehicle types that is, the typical number of pieces of lumber and their dimensions for each vehicle type. After this joint enumeration exercise, the enumerators were left alone to continue with the data collection for a period

of two weeks. This was between November and December 2012, the months, which has been described by Hansen *et al.* (2012) as the peak period (when large volumes of lumber are cart to the timber markets because of the good weather, which makes most of the roads motorable). No data was collected during the wet (low) season.

The study adopted the same vehicle types and their respective codes as used by Hansen *et al.* (2012). As the counting of lumber pieces per dimensions per vehicle was seemed to be very laborious, the enumerators for this study closed at 8.00pm instead of the 12-hour shift method as used by the former study. In this case the registration numbers of vehicles that were not off-loaded before departure were recorded in order to identify those that arrived in their absence. This enabled them to enumerate such vehicles. The enumerators were paired to enable them work more effectively. Within the two-week data collection period the research team played a supervisory role by visiting enumerators on-site and also engaged them in telephone conversations with the aim of encouraging them and cross checking the data collection process. Photographs of loaded vehicles were taken. Additional data was collected for a day at each site by CSIR-FORIG research team without the enumerators after the two-week period. This was done as an independent means of verification of the data as captured by the field enumerators.

Therefore this study, which included some methodologies by Hansen *et al*. (2012), considered the following steps in determining the lumber supply into the three timber markets that were selected: the counting of lumber pieces per vehicle type that entered any of the timber markets, random measurement of lumber (thickness and width), identification of the timber species being cart, counting of the types of vehicles with lumber that made appearance at the markets, interviewing of the timber dealers/drivers and enumerators closing at 8.00pm. This approach is termed as "Inquisitive Estimates of Lumber Volume Supply" (IELVS). Data from the three different markets were entered using Excel spreadsheets.

3 RESULTS AND DISCUSSION

3.1 Observations

3.1.1 Vehicle loading and lumber dimensions

Observations made on the level of loadings of the vehicles are shown in Plates 1 to 4. These include loads just above the bucket level (Plate 1), loads far above the bucket level (Plate 2), loads extended to the tail board (Plate 3) and loads with different dimensions of lumber per vehicle (Plate 4). In some cases non-lumber items like vehicle tyres (Plate 4), charcoal and chew sticks were loaded in the empty spaces of the vehicles. All the vehicles assessed were loaded with at least two different lumber dimensions. Some of the results from the interviews revealed that the loading of the vehicles with chainsaw lumber was dependent on factors such as the condition of the road to the domestic market, the situation at the site where chainsaw milling takes place, the readiness of the lumber dealer (owner of the lumber) to pay extra for over loading of the vehicle, the type of species (high, medium, or low-density), the dimensions of lumber, quantity of lumber pieces at the loading/milling site, the distance from the loading or milling site to the market and the condition of the vehicle. For these reasons, in addition with Plates 1 to 4, there was the need for physical assessment of the contents of vehicles that enter the timber markets in estimating the volumes of lumber supply in order to avoid under or over estimation of lumber inflows. The quantities of lumber loaded in any of the vehicle types, as mentioned by the timber dealer/vehicle drivers, were different at each of the three timber markets.

Timber products observed at Muus in Accra were in the forms of (thickness x width – in inches) 1x12, 2x6, 4x6 and 4x12 both in short/long lengths. The lumber dimension types at Sokoban, Kumasi were 1x12, 1.5x12, 2x4, 2x6 and 4x12 while those at Techiman were 1x12, 1.5x12, 2x4, 2x6, 2x7, 4x12. From Obiri *et al.* (2009) the dimensions identified at the regions where these three markets are located varied widely in comparison with these results. The reason is that while this study looked at the lumber volumes (pieces) that were loaded in vehicles entering the market, the former study looked at the lumber volumes in the market, which were made up of sawmill lumber, bush cut lumber and "bush cut lumber" re-sawn into smaller thicknesses and widths. This is possible because of the facilities (mobile milling machines and

table/rip saws) available at some of the market centers. Bush cut (chainsaw) lumber are in most cases milled into thicker and wider dimensions to facilitate operation (increase the rate of milling and loading).

1a

1b

1c

Plate 1: *Loads of vehicles just above the bucket level but with spaces unloaded*

2a

2b

2c

Plate 2: *Loads of vehicles above the bucket level*

Plate 3: *Loads extended to the tail board of some vehicles*

4a 4b

Plate 4: *Loads with different dimensions of chainsaw lumber*

3.1.2 Arrival of vehicle types

The initial study undertaken by FORIG team and the enumerators and the dealers that were interviewed revealed that vehicles entering the market in the night (after about 10pm) were very few and their contents were not discharged until the next day between 7.00am and 8.30am (depending upon the market) when the dealers and labourers had arrived. Figure 1 shows the period of which vehicles that cart chainsaw lumber arrived at three domestic markets. It indicates that period of arrival of vehicles at the timber market varies from place to place. Generally, with respect to the arrival of the vehicles that were recorded within the period 8.00pm and 5.00am, 62% arrived between 8.30pm and 9.30pm and 3.15am and 5.00am. From the three timber markets 104 vehicles, representing 22%, arrived in the night (8.00pm – 5.00am) while 21% arrived between 5am and 8am.

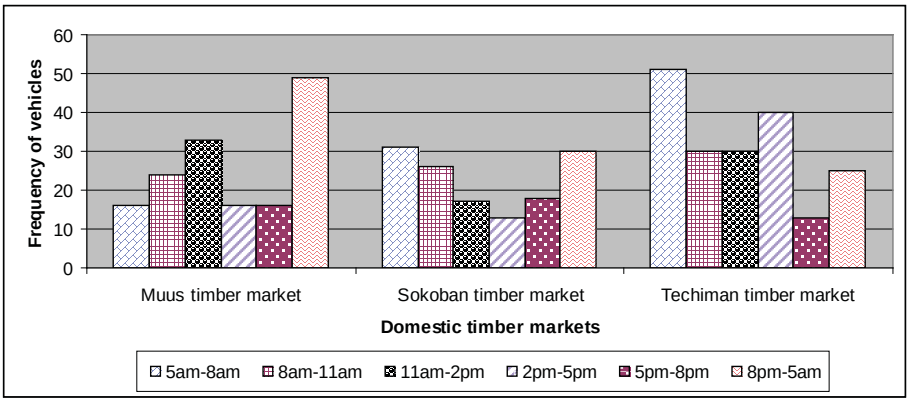

Figure 1: *The period of arrival of vehicles carting chainsaw lumber to the three domestic markets.*

Between the periods of 8am-11am and 11am-2pm 17% of the vehicles each was recorded. Some vehicle drivers and timber dealers interviewed said that the periods of arrival of vehicles had been studied to be quite free of the presence of the security on the route that they ply. This suggests that the presence of security personnel on the roads may influence the arrival of vehicles at the markets, especially for dealers who are not prepared to incur any cost in relation to business offenses on the road.

3.1.3 Vehicle types identified

The types of vehicles that were identified during the two week study at each of the three markets are shown in Table 1. Six (6) different vehicles were identified at Muus market while 9 and 5 vehicle types were identified at Sokoban and Techiman markets respectively. All the vehicles identified are also recorded in the study by Hansen *et al.* (2012). The mean frequency of vehicles that entered Muus, Sokoban and Techiman markets per day were estimated to be 11, 10 and 8 respectively indicating that on the average vehicles that entered Muus timber market per day were more than the other two markets. The total number of vehicles that were counted at the three markets during the two-week enumeration period was 478. The first three vehicle types with the highest number of counts were Kia (32.4%), Kia Rhino (23.2%) and Double axle cargo (18%). This shows that they were the vehicle types mostly used for carting lumber to the three domestic lumber markets.

Table 1: *Types of vehicles identified at the three timber markets*

Vehicle code	Type of vehicle	Muus timber market	Sokoban timber market	Techiman timber market
V1	Single axle cargo	√	√	√
V2	Double axle cargo	√	√	√
V3	Half-load cargo	√	√	√
V4	Kia	√	√	√
V5	Tractor		√	
V6	Benz 1113		√	
V8	American Ford		√	
V9	Articulator	√	√	
V10	Kia Rhino	√	√	√

The three most regular vehicles entering Muus market in Accra per day in descending order are double axle cargo, Kia and Kia Rhino. Those for Sokoban are double axle cargo, Kia and Half-loaded cargo while Techiman recorded

Kia, Kia Rhino and double axle cargo in the same order. Kia and Kia Rhino were therefore the two dominant vehicles types with the highest frequency of entry at the three domestic timber markets.

3.2 Chainsaw lumber volumes

The monthly means of all the vehicle types enumerated during the study were estimated. The annual mean estimates were subsequently established from the monthly mean. These are compared with those estimates obtained by Hansen *et al*. (2012) for the three markets that the current study considered. Based on the results the two methodologies, "Around-the-Clock Monitoring of Lumber Inflows" and "Inquisitive Estimates of Lumber Volume Supply" are discussed.

3.2.1 Inflow of chainsaw lumber at three timber markets (mean volumes)

From Table 2, the mean lumber volumes registered by the vehicle types ranged between 11.6 and 73.4 m^3 for the Muus market, 8.7 and 45.1 m^3 for the Sokoban market and 10.7 and 30.1 m^3 for Techiman market. The standard deviation for each of the vehicle type per timber market indicates that volume per entry was not constant and hence had an influence on the mean. This confirms the observation that the same type of vehicle (for instance Kia) arriving at the market several times will have different contents (plates 1-4), which may be difficult for the timber dealers to record especially where the market is large and also proper record keeping is not undertaken. Some of the dealers interviewed indicated that at the "hot spots" areas (sites where chainsaw monitoring by task force is very strict) milled lumber are not left there for long but are immediately taken away to avoid stealing, and or seizure of the product or arrest of the chainsaw operators. Therefore in such situations vehicles may or may not be over loaded.

Table 2: *Mean volumes of vehicles identified per timber market in the dry season*

Timber market	Statistics	V1	V2	V3	V4	V5	V6	V8	V9	V10
Muus	Mean	45.2	73.4	11.6	14.0				48.5	26.6
	Standard dev	27.4	25.6	1.0	7.3				13.5	20.6
Sokoban	Mean	29.0	45.1	29.8	8.7	9.8	13.3	9.9	41.3	29.5
	Standard dev	12.5	12.0	17.6	6.2	6.2	10.4	6.2	38.1	16.0
Techiman	Mean	17.9	25.7	30.1	13.3					10.7
	Standard dev	1.6	2.0	9.6	3.9					3.4

V1 to V10: Types of vehicles for carting lumber

Generally any particular vehicle that entered Muus, Sokoban and Techiman timber markets contained a mean volume of 36.6 m^3, 24.1 m^3 and 19.5 m^3 respectively with standard deviations of 23.7, 14.1 and 8.2 in the same order of arrangement.

3.2.2 Mean volumes of vehicle types

The mean volume of each vehicle type from the three timber markets studied and that of Hansen *et al*. (2012) (in brackets) are shown in Table 3. The range of the mean lumber volumes was 9.8 to 55.8 m^3 with the minimum and maximum means recorded by tractor/ American ford and Double axle cargo while those from Hansen *et al.* (2012) ranged between 3.2 m^3 (American ford) and 46.9 m^3 (Articulator).

Table 3: *Mean lumber volumes (m^3) of vehicle types identified at three timber markets during the dry season in comparison with that of [Hansen et al., 2012]*

Type of vehicle	Mean	Standard dev	Minimum	Maximum
Single axle cargo	39.6 [18.3]	25.2 [6.9]	9.4 [11.4]	109.4 [25.2]
Double axle cargo	55.8 [28.2]	23.8 [10.7]	7.7 [17.6]	132.2 [38.9]
Half-loaded cargo	26.4 [21.2]	16.3 [6.5]	8.3 [14.7]	66.1 [27.7]
Kia	12.4 [8.7]	5.9 [2.7]	0.13 [6.0]	50.6 [11.4]
Tractor	9.8 [4.9]	6.2 [1.3]	3.3 [3.5]	21.1 [7.5]
Benz 1113	13.3 [17.7]	10.4 [5.3]	4.7 [12.3]	28.3 [23.0]
American Ford	9.9 [3.2]	6.2 [1.5]	4.7 [1.7]	17.0 [4.7]
Articulator	46.8 [46.9]	21.3 [17.7]	4.6 [29.2]	120.4 [64.6]
Kia Rhino	17.7 [15.4]	15.3 [4.8]	7.6 [10.7]	67.7 [20.2]

*[ ] = Results from study by Hansen *et al*. (2012)

The mean volumes recorded for all the vehicles were higher than those by Hansen *et al.* (2012) except the Benz and Articulator vehicle types. These include the counting of lumber pieces per vehicle type and recording the different dimensions of lumber including the quantity of each lumber dimensions that were loaded in the vehicle. Plates 1 to 4 show vehicles with different lumber dimensions and the levels (both vertically and horizontally) at which buckets of vehicles were loaded. Hence chainsaw lumber supply to the markets can be over or under estimated if on the spot lumber counting and identification of lumber dimensions are ignored. The minimum and maximum values including the standard deviations also indicate that the volumes of lumber recorded for each vehicle during this study were more dispersed as compared to that of the former study (Table 3). Therefore relying on vehicle counts and interviewing of timber dealers at the timber markets for the lumber volumes of vehicles alone may not produce a more reliable data for the estimation of the inflows of illegal lumber volumes to the various timber markets in Ghana.

3.2.3 Periodic inflows of chainsaw lumber

Table 4 shows the periodic estimates of the total volumes of lumber inflows at each of the three timber markets for both current and former studies. The estimates by Hansen *et al* (2012), which are in the brackets, comprise the mean estimated monthly inflow of lumber during the dry season (peak season) and the high estimated annual inflow of lumber to each of the three surveyed markets.

Table 4: *Annual volumes of lumber (m³) estimated for the three timber markets in the dry season (peak period) in comparison with Hansen et al. (2012)*

Timber market	Estimated volume within study period (m³)	Estimated volume per month (m³)	Estimated annual volume inflow of timber (m³)	Estimated annual volume inflow of wood in RWE (m³)
Muus	6,295	12,590	151,083	498,573
		[19,869]	[238,685]	[787,661]
Sokoban	3,816	7,631	91,571	302,185
		[11,285]	[134,241]	[442,995]
Techiman	2,975	5,950	71,402	235,628
		[19,292]	[226,632]	[747,886]
Total	13,086	26,171	314,056	1,036,386
		[50,446]	[599,558]	[1,978,541]

*[ ] = Results from study by Hansen *et al*. (2012)

The results of the study by Hansen *et al*. (2012) are higher than those estimated by this study. This could be attributed to the frequency of the vehicles (the number of vehicle counts) that entered the three markets, taking cognizance of the lower mean volumes of vehicle types recorded as shown in Table 3. The number of counts of the vehicle types and market centers are not recorded in the results of Hansen *et al*. (2012). The ratio of the volumes of lumber generated per period in the former study to that of the latter for each

of the three market centres Muus, Sokoban and Techiman were estimated to be 1.6, 1.5 and 3.2 respectively. This implies that the lumber inflow at Techiman market as recorded by Hansen *et al* (2012) was more than three times that of the latter study while Muus and Sokoban were about twice. The difference in the chainsaw lumber supply into the domestic market, which is 0.94 million cubic meters, could be attributed to the modification of the former methodology, which is termed as "Inquisitive Estimates of Lumber Supply" (IELVS) approach, where deeper assessment of the contents of all the vehicles was strictly adhered to.

3.2.4 Assessment of the modified methodology

Physical assessment of the content of vehicles to identify the dimensions of lumber and the counting of the pieces of lumber per dimensions per vehicle type were used to estimate the lumber volumes for the vehicle types in addition to the vehicle counts. These were additional approaches to the former studies. In the study by Hansen *et al*. (2012) the methodology used dwelt on:

(a) lumber volumes per vehicle types (of which the means were derived) where estimates were made from an interview with the timber dealers and drivers who cart lumber to the market centres

(b) counting of the vehicles that entered the markets. In this case some factual information may not be fully provided since the dealers would want to protect their businesses for the future

(c) type of timber species

(d) the estimates for lumber leakages that the former methodology could not capture were assumed to be too high. In a situation where the name of the species (given by driver or mate) is wrongly mentioned, the volume estimates for that particular vehicle type will be affected, hence the final results.

The approach for this current study (Inquisitive Estimates of Lumber Supply) may minimize the estimates assumed for chainsaw lumber leakages. Therefore this "Inquisitive Estimates of Lumber Volume Supply" approach will be more reliable to be used for data collection for the estimation of lumber inflows to the timber markets in Ghana.

The results on the load per identified vehicle type obtained by the CSIR-FORIG team before and after the enumerators' survey varied from the

interview results that were provided by the timber market dealers. This could be due to the difficulty in defining a full or near full loaded vehicle. Also their interpretation that when a particular lumber dimension dominates in a loaded vehicle, that dimensions of lumber is taken as the full load of the vehicle is erroneous. For instance, when a loaded vehicle type (Kia) is mostly made up of a thickness and width (in inches) of 2x6 lumber, the volume of the content is estimated based on the quantity of 2x6 lumber that the vehicle can carry, which they specify as 250-300 pieces depending upon the species. The modification in the 12-hour shift (Around-the–Clock Monitoring of Lumber Inflows) method, which is termed as "Inquisitive Estimates of Lumber Volume Supply" approach helps the enumerator to ascertain the source of the product as either sawmill or chainsaw lumber, identify the species and various lumber dimensions, provide a slight opportunity for lumber measurement to confirm dimensions of lumber and reveal the actual quantities of the lumber in a vehicle type. The results also indicate that few vehicles generally enter the markets in the night (9pm to 5am). This confirms the report by Hansen *et al.* (2012) that many vehicles arrive at the timber markets early in the morning. Since enumerators at the various markets collected the data for analysis, the accuracy of the new methodology, "Inquisitive Estimates of Lumber Volume Supply" approach, will depend on them, hence the need to have close supervision and consistent checks of their records for such a study. The disadvantage of this new approach of lumber volume estimates is that it is too inquisitive, labour intensive and more risky than the other approaches.

4 CONCLUSIONS

The results of the study estimates the inflows of lumber at three major timber markets in Greater Accra region (Muus), Ashanti region (Sokoban) and Brong Ahafo region (Techiman). The methodology used, Inquisitive Estimates of Lumber Volume Supply (IELVS), were through interviews, direct observation of transport vehicles by counting the types of vehicles entering the timber market, counting the quantities of lumber per vehicle and per lumber dimensions, identifying the type of wood species and taking photographs of some scenes.

The study reveals that loading of the vehicles with chainsaw lumber may depended on factors like the condition of the road to the domestic market, the situation at the site where chainsaw milling takes place, the readiness of the lumber dealer (owner of the lumber) to pay extra for over loading of the vehicle, the type of species (high, medium, or low-density), the dimensions of lumber, quantity of lumber at the loading/milling site, the distance from the loading/milling site to the market and the condition of the vehicle type.

The mean lumber volumes of any of the identified vehicle types varied from market to market and that the estimates in this study were higher (with the exception of the Benz vehicle) than those by Hansen *et al.* (2012). The mean volumes for this study ranged from 9.8 m^3 (Tractor/American Ford) to 55.8 m^3 (Double axle cargo) as against 3.2 m^3 (American ford) to 46.9 m^3 (Articulator). The annual inflow of chainsaw lumber in terms of round wood equivalent (RWE), which is based on the peak period (dry season), to the three markets was estimated to be 1.04 million m^3 as against 1.98 million m^3 by Hansen *et al.* (2012). Muus market recorded the highest wood volume of 151,083 m^3 followed by Sokoban (91,571 m^3) and Techiman (71,402 m^3). The "Inquisitive Estimates of Lumber Volume Supply" approach, which is a modification of Hansen *et al.* (2012) method, has been tested and seems to give a better estimate on the content of any vehicle entering a timber market and hence could be used for future studies. The only disadvantage is the high risk that the team members, especially enumerators are exposed to, which can be managed by the establishment of mutual understanding between members.

Since the sample size of the study was not representative, the actual annual national lumber volume supply was not determined. It is therefore recommended that a survey of domestic lumber market be undertaken to estimate the annual lumber volume supply using the recommended approach.

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REFERENCES

Abroquah, E. 2004. Measures to curb chain sawn lumber production and the degree of success. In Nketiah, K.S., Wieman, A. and K.O. Asubonteng (eds.). Chain-saw lumber production: a necessary evil? Workshop Proceedings 2. Focus group discussion at a workshop held at the Wood Industries Training Centre (WITC), Akyawkrom, Ejisu, Kumasi on 11 November 2003. Tropenbos International – Ghana, Kumasi, Ghana: 19-21.

Adam, K.A., Pinard, M.A., Cobbinah, J.R., Damnyag, L., Nutakor, E., Nketiah, S.K., Boateng, K., Nyarko, C., 2007. Report on corruption in the chainsaw milling and lumber trade in Ghana. FORIG, Tropenbos International Ghana and University of Aberdeen.

Agyeman, V.K., Agyeman, F. and Kyereh, B. 2004. Illegal chainsaw operations: Impact, constraints, challenges and policy reform. in Nketiah, K.S., Wieman, A. and K.O. Asubonteng (eds.). Chainsaw lumber production: a necessary evil? Workshop Proceedings 2. Focus group discussion at a workshop held at the Wood Industries Training Centre (WITC), Akyawkrom, Ejisu, Kumasi on 11 November 2003. Tropenbos International – Ghana, Kumasi, Ghana: 32-40.

Agyeman, V. K., Marfo, K. A., Kasanga, K., Danso, E., Asare, A. B., Yeboah, O. M., and Agyeman, F. (2003). Revising the Taungya Plantation System: New Review–Sharing Proposals from Ghana. Report for FAO.

Birikorang, G., Hansen, C.P., Treue, T. 2007. Fiscal study report. Validation of Legal Timber Programme, Forestry Commission, Accra.

Birikorang, G., Okai, R., Asenso-Okyere, K., Afrane, S., Robinson, G., 2001a. Ghana wood industry and log export ban study. Forestry Commission report to the Ministry of Lands and Forestry. Forestry Commission, Accra, Ghana. 53 pp.

Birikorang, G., Okai, R., Asenso-Okyere, K., Afrane, S., Robinson, G. 2001b. Ghana wood industry and log export ban study. Annex 1–15. Forestry Commission report to the Ministry of Lands and Forestry. Forestry Commission, Accra.

Blackett, H., Gardette, E. 2008. Cross-border flows of timber and wood products in West Africa. Final report of the European Commission 2007/146818, printed by HTSPE Ltd., United Kingdom. 125pp

Chatham House, 2010. Illegal Logging and Related Trade: Indicators of the Global Response. Chatham House, London. 8pp

Damnyag, L, and Obiri, D.B. 2009. Structure of the chainsaw lumber production enterprise In Marfo, E., Adam, K. A. and Obiri, B.D. (eds.) *Ghana case study of illegal chainsaw milling. Developing alternatives to illegal chainsaw milling through multi-stakeholder dialogue in Ghana and Guyana project.* FORIG Research Report (CSIRFORIG/ TR/ EM;KAA;BDO/2009/18). Pp 23-31

Fehr, C. and Pasiecznik, N.M. 2006. The potential of chainsaw milling for improving rural livelihoods in Uganda and DR Congo. Henry Doubleday Research Association, Coventry, DFID/FRP R8510, UK.

Fobih, D., 2003. Keynote address. In: Nketiah, K.S., Wieman, A., Asubonteng, K.O. Eds). Chainsaw lumber production: a necessary evil? Workshop Proceedings 2. Tropenbos International, Wageningen, the Netherlands. 79pp

Hansen, C.P., Damnyag, L., Obiri, B.D., and Carlsen, K. 2012. Revisiting Illegal Logging and the Size of the Domestic Timber Market: The Case of Ghana. Commonwealth Forestry Association: International Forestry Review, 14(1):39-49. http://www.bioone.org/doi/full/10.1505/146554812799973181. Accessed 19/01/12

Hansen, C.P., Treue, T and Birikorang, G. 2007. The regulation of commercial timber exploitation in Ghana's high forest zone between 1996 and 2005. Validation of Legal Timber Programme, Forestry Commission, Accra

Marfo, E. (2012). Personal communication on "lumber supply to the domestic timber market in Ghana". Held on 23rd May 2012.

Marfo, E. (2010) Chainsaw Milling in Ghana: Context, drivers and impacts. Tropenbos International, Wageningen, the Netherlands. 76pp.

Marfo, E. amd Azu, C.T. 2009. Analysis of policy and legal framework of chainsaw milling and trading in Ghana. In Marfo, E., Adam, K. A. and Obiri, B.D. (eds.) *Ghana case study of illegal chainsaw milling.*

Developing alternatives to illegal chainsaw milling through multi-stakeholder dialogue in Ghana and Guyana project. CSIR-FORIG Research Report (CSIRFORIG/TR/EM;KAA;BDO/2009/18). Pp 23-31

Marfo, E., 2003. Coping with illegality: Conflicts over chainsaw lumbering and coping strategies. In: Nketiah, K.S., Wieman, A., Asubonteng, K.O. Eds). Chainsaw lumber production: a necessary evil? Workshop Proceedings 2. Tropenbos International, Wageningen, the Netherlands.

Obiri, D.B. and Damnyag, L, 2009. Market and financial environment of chainsaw milling in Ghana. In Marfo, E., Adam, K. A. and Obiri, B.D. (eds.) *Ghana case study of illegal chainsaw milling. Developing alternatives to illegal chainsaw milling through multi-stakeholder dialogue in Ghana and Guyana project.* CSIR-FORIG Research Report (CSIRFORIG/ TR/EM;KAA;BDO/2009/18). Pp 59-74

TIDD/FORIG, 2009. Supply and demand for lumber on the Ghanaian domestic timber market. Commissioned under Natural Resources and Environmental Governance Programme. Final report submitted by CSIR-FORIG to FC-TIDD. 116pp

Odoom, F.K., 2005. A study of chain sawing in the natural forests of Ghana. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. 76 pp.

Odoom, F.K. 2004. A study of chain sawing in the natural forests of Ghana. Food and Agriculture Organization of the United Nations (FAO), Rome.

Owusu, A. 2004. Halting chainsaw lumber production: counting the cost. in Nketiah, K.S., Wieman, A. and K.O. Asubonteng (eds.). Chain-saw lumber production: a necessary evil? Workshop Proceedings 2. Focus group discussion at a workshop held at the Wood Industries Training Centre (WITC), Akyawkrom, Ejisu, Kumasi on 11 November 2003. Tropenbos International – Ghana, Kumasi, Ghana: 49-53.

Parren, M.P.E., Cardoso, R.D., Okai, E.N.A., Eshun, A.A. and Haizel, K.E. 2007. Review of the domestic timber market with an emphasis on Off-Forest Reserve timber production and management in Ghana. Validation of Legal Timber Programme (VLTP) Background Paper No.

2. Validation of Legal Timber Programme, Forestry Commission, Accra, Ghana. 20pp

Sarfo-Mensah, P. 2005. Exportation of Timber in Ghana: The Menace of Illegal Logging Operations. Nota Di Lavoro 29

Tropenbos International Ghana Programme, 2007. Developing alternatives for illegal chainsaw lumbering through multi-stakeholder dialogue in Ghana and Guyana. Project proposal submitted to the EU.

Referenced Acts and legal instruments

The Trees and Timber (Chain-saw Operations) Regulation, 1991 (LI 1518)

The Ghana Investment Promotion Act, 1994 (Act 478)

The Free Zone Act, 1995 (504)

The Timber Resources Management Act, 1997 (Act 547)

The Timber Resources Management Regulation, 1998 (LI 1649)

APPENDICES

Appendix 1: Questionnaire used to discuss challenges with some former enumerators who assisted in data collection at the timber markets

1. What is your name?

2. Were you one of the enumerators during the last study?

3. If yes, which of the timber markets was your study site?

4. How many people did you work with?

5. What part did you play?

6. What were some of the challenges that you encountered?

   - Data collection forms
   - Identification of vehicles loaded with lumber
   - Determination of the quantities of lumber

7. Is it possible to count the lumber pieces per vehicle arriving at the timber market?

8. What pieces of advice will you give to better future studies?

9. Could you be available to work with us again on the same study?

10. Can you recommend two other people to assist in the future study?

Appendix 2: Forms used for the collection of data on vehicles carrying lumber into markets

Form for collection of data on vehicles carrying lumber into markets

Name of market, city and region: _____ Name of recorder: _____

Date (dd/mm/yy) The date the vehicle arrives	**Time** (hh:mm) The time that the vehicle arrives	**Vehicle type** See reference no. in picture sheet or back of the sheet	**Supply source** CL: Chainsaw lumber (bush cut), SM: Sawmill lumber	**Qty of lumber** 2x4	**Qty of lumber** 2x6	**Qty of lumber** Boards	**Qty of lumber** Beams

Signature of recorder: _____

VEHICLE TYPES

Characterize the vehicle with a code, according to the below table. See also the picture sheet. Use only the vehicle code indicated in the first column of the Table 2.

Table 2: Identified vehicles used to cart lumber to timber markets

Code	Vehicle type
1	Single axle-full load – identified by one set of tyres at the back
2	Double axle-full load – identified by two set of tyres at the back
3	Cargo one and half load
4	Kia
5	Tractor
6	Benz
7	Cargo 207
8	American Ford
9	Articulator
10	Kia Rhino

Table 3: **Supply source**

Code	Description
CL	Chainsaw lumber (bush cut)
SM	Saw mill lumber

Note that:

- Vehicles carrying chainsaw lumber(bush cut) are normally covered as their identification mark
- Vehicles carrying sawmill lumber to the market centre are normally not covered and are usually tractors and Kias

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This report was produced within the framework of the EU Chainsaw Milling Project "Supporting the integration of legal and legitimate domestic timber markets into Voluntary Partnership Agreements". The project aims to find sustainable solutions to the problems associated with the production of lumber for local timber markets by involving all stakeholders in dialogue, information gathering and the development of alternatives to unsustainable chainsaw milling practices. In Ghana, the project is being carried out by Tropenbos International (TBI) in collaboration with the Forestry Research Institute of Ghana (FORIG) and the Forestry Commission (FC).

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