



Assessing the high rate of deforestation caused by the operations of timber companies in Ghana

Obed Asamoah *

Department of Bioresources and Forest Sciences, School of Forest Sciences, University of Eastern Finland, Finland

Abstract

Forests are very vital for human survival and our well-being. The high rate of deforestation in Ghana is of major national concern as the forests provide many ecosystem services and functions that support the country's predominantly agrarian economy and foreign earnings. The causes of deforestation are varied but can broadly be categorized into anthropogenic and natural factors. Several studies have been conducted regarding the causes of the high rate of deforestation in Ghana. The operations of timber companies in the forest have not caught the attention of researchers as one of the reasons for deforestation in Ghana. The main objective of this study is to find out the harvesting methods and the activities of the timber production companies and their effects on forests in Ghana. The qualitative research method was used in this research. The study population comprised of 20 timber companies (sawmills) in forest areas of Ghana. The cluster sampling technique was used to select the respondents. It was observed that most of the timber production companies do not know the age, the weight, the distance covered from the harvesting to the loading site in the forest. It was also observed that old and heavy machines are used by timber production companies in their operations in the forest which destroys a lot of juvenile trees, makes the soil compact, prevents regeneration, and enhances soil erosion. It was concluded that Ghana Forestry Commission should monitor the activities of the timber production companies and sanction those that make damage to the forests.

Keywords: Deforestation; Forest; Ghana; Industries; Timber

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* Corresponding author. *E-mail address:* obeda@student.uef.fi

1. Introduction

Ghana is characterized by natural forests which give it unique and diverse resources, tropical climate, and unique environmental conditions. A forest ecosystem is a natural woodland unit consisting of plants, animals, and microorganisms (biotic) in an area functioning together with all the non-living physical (abiotic) factors of the environment. This means that the definition of forest is not limited to only plants but includes animal species as well as abiotic factors such as soil and other minerals. There are interdependence and interrelationship among all the factors that make up the forest. For example, the plants cannot grow without soil and mineral salts that they use as their sources of nutrients (Quacou, 2016).

This had given the country unique climatic conditions until the 20th century; however recently, the rate of exploitation has increased as a result of population growth and an increasing need for infrastructural development. Ghana has one of the highest deforestation rates in Africa and the world. Between 1990 and 2000, Ghana lost an average of 135,000 hectares of forest per year; amounting to an average annual deforestation rate of 2% (Gyampoh, 2011; FAO, 2010a). Between 2000 and 2005, Ghana's forests decreased by a further 115,000 hectares, with a forest change rate of 2% per annum. In total, between 1990 and 2005, Ghana lost 1,931,000 hectares or 26% of its forest coverage (Anon, n.d.; Amisah et al., 2009; Idinoba et al., 2010). Measuring the total rate of habitat conversion (defined as a change in forest area plus the change in the woodland area minus net plantation expansion) for the 1990-2005 interval, Ghana has lost 27.6% of its forest and woodland habitat. It is known that Ghana has the highest rate of deforestation, out of 65 nations, apart from Togo and Nigeria (Keenan et al., 2005). Both legal and illegal acts of cutting trees have contributed to this high deforestation rate. The harvesting methods of timber production companies also have had negative effects on the forests.

According to the annual reports by FAO (2010b), 13 million hectares of forests are lost per year globally and Africa alone contributes to 3.4 million hectares of this loss. The situation is not different in Ghana where deforestation is also quite high. The country has a total land area of 23.85 million hectares. At the beginning of the 20th century, 8.2 million hectares of this area were covered by forest and the rest by other types of vegetation such as Sudan and guinea savannahs. Forest cover however keeps reducing and by the 1950s, it had been reduced by half to about 4.2 million hectares. It was further reduced to about only 1.9 million hectares by 1999 (Affum-Baffoe, 2009). Recent data from mongabay.com indicated that between 1990 and 2000 alone, the annual deforestation rate was 1.8%.

Several factors account for the high rate of deforestation in Ghana and most of them are interrelated. The primary causes of deforestation are anthropogenic and can be linked to livelihood, survival, and development at both the sub-national and national levels. At the national level, for example, timber accounted for the fourth highest foreign exchange earner for the country in the year 2014. A total of about 249,846 m³ of timber worth €98.5 million was exported in the first three quarters of the year 2014 (Anon, n.d.). This contributes significantly to the rate of deforestation in the country. At the sub-national level, agriculture employs about 60% of the population directly or indirectly. All the activities of the population engaged in the agricultural sector also have a direct contribution to the high rate of deforestation in the country (Culas, 2007). These causes can further be classified into indirect and direct causes. The indirect causes are those factors that trigger deforestation. In the cocoa-growing regions of Ghana, which also happen to be in the forest areas, large tracts of tropical forests have been cleared to support increasing cocoa cultivation. Ghana's economy is agriculturally

based with lots of income coming from cocoa exports and coca processing in the country. At present, Ghana is the world's second-largest producer of cocoa beans (Vigneri and Kolavalli, 2017). When the global cocoa price is low, Ghana's foreign exchange earnings are significantly affected; this is often compensated for by increasing timber and mineral exports. Thus, cocoa farming is both a direct and indirect driver of deforestation (Gibbs et al., 2010).

Several works have been conducted regarding the causes of the high rate of deforestation in Ghana; the focus has been on illegal logging and using forest lands for illegal farming and mining activities. Less attention has been placed on the timber production companies, their harvesting methods, and other operations that are carried out in the forest. The kinds of machines that are used for harvesting and the harvesting methods have effects on the forest as far as regeneration concerns. Tones of juvenile trees and shrubs are destroyed in their operations in the forest. Large chunks of wood are wasted in the timber production process by the timber industries in their operations. Large sums of wood are considered as waste and burnt without utilizing it for other products that can be useful. High volumes of wood are wasted in the operations by timber production companies in Ghana. The rate at which wood is wasted by these companies pushes the timber companies to harvest more wood to reach their annual production level.

The annual allowable cut (AAC) in Ghana is always estimated because the Ghana Forestry Commission has no accurate total number of timbers in the forest reserves (Chazdon, 2003; Quacou, 2017). In 1990, the Forest Services Division estimated that the AAC for already exported species was 1.2 m³/ha/year. This brought the AAC at 1.2 million m³. However, in 1995, it was found that this production rate was not sustainable since most of the forests were progressively depleted in stocks of some major species. This study aims to investigate the harvesting methods by timber production companies and their contribution to deforestation in the country. It also overviews the required machines recommended by the Ghana Forestry Commission to be used by the timber production companies. Therefore, the main objective of this study is to find the harvesting methods and the activities of the timber production companies, the machines they use, and the effects of their activities on forests in Ghana.

1.1. Damages caused by the harvesting process by timber production companies

Several damages are caused by timber production companies in the harvesting process from the logging or felling point to the loading point in their harvesting operations in the forest. Skidding off the timbers from logging to loading points results in the high destruction of juvenile trees and shrubs. Logs are usually dragged ("skidded") from their stump to the loading bays, leaving skid trails. Loading bays and roads are completely cleared of vegetation, and the soil often becomes degraded through compaction which results in poor regeneration. However, because they are reused in each cycle, and one or two will suffice for a large logging compartment, their impact is perhaps more minimal than that of the skid trails and felled tree gaps (Hawthorne et al., 2011). In the felling process, other trees and shrubs are destroyed while others are injured. Large sums of juvenile trees are destroyed in the harvesting process which also contributes to deforestation in the forest. Felling injures neighboring trees, especially crowns, skidding tends to increase mortality in the very short-term (Bertault and Sist, 1997). In other circumstances, logging disturbance may create an unfavorable environment, particularly if combined with heavy harvest pressure (Chazdon, 2003).

1.2. Study area

The Republic of Ghana is a country situated on the Gulf of Guinea, within the subregion of the geographic area. Ghana features a landmass spanning 238,535 km², equivalent to (92,099 km³), Ghana shares its borders with Cote d'Ivoire to the west (a part of Ghana), Burkina Faso to the north, Togo to the east and the Gulf of Guinea, part of the Atlantic Ocean, to the south.

The Closed Forest Zone is classed into the evergreen forest, evergreen damp Forest, and the most abundant semi-deciduous Forest. In 1992, it was made known that 1.5 million ha of "intact closed forest" were remaining in Ghana. The annual rate of deforestation within the country was said to have slowed within the 1980s to approximately 22,000 ha.

The evolution of the forest cover in Ghana can compare with Côte d'Ivoire, with a parallel decline since the 80's due to the very same main drivers of conversion: cocoa area expansion and other perennial crops (FAO, 2015), the forest area of Ghana is 9.34 million ha, with an average deforestation rate of 28,400 ha/year for the 2000–2015 period. For Global Forest Watch GFW, it is 7 million ha (30% threshold) with an average tree loss of 40–60,000 ha/year, and of only 207,000 ha of dense forest (Alpert, 1993). Approximately, 1.6 million ha are gazetted as forest reserves. A 2014 map of canopy cover of forest reserves in Ghana showed the degradation and deforestation of many of them.

2. Materials and methods

The data for this research were collected in Ghana, in 5 selected regions and 10 randomly selected districts where most of the timber companies are established. The data were collected from April to June 2019. The study population comprised 20 randomly selected timber industries in the 5 selected regions. (Western North, Western Region, Ashanti region, Eastern Region and Bono Ahafo region) and 10 districts, 2 companies from each of the 10 selected districts (Creswell and Plano, 2014).

A cluster sampling technique was used to select the respondents (Timber companies). Secondary data were used in this study. Secondary data from timber companies on the weight, size, and type of machines used for harvesting in the forest. Records on wood waste and the number of lumber produced per year were taken. The field survey used a structured questionnaire comprising both open- and closed-ended items. The questions were designed to gather data on the harvesting methods and to find out the kind of machines that are used for harvesting, skidding, and loading of timber in the forest. The survey was also used to find out the distance covered by timber companies from the harvesting point to the loading point in their operations in the forest. The selected domestic interviewees were helped by a local person who interpreted the questions made in the English language to the operators who do not understand English.

A copy of this questionnaire can be found in the electronic supplementary material. The questionnaire with 20 questions was administered to the 20 randomly selected timber production companies. Key informant interviews were engaged with the management of selected timber production industries to find out the age, of their machines used for their operations if it is in line with the rules that govern their operation in the forest. Personal field observations were employed in the data collection; this helped the authors to come up with a structured questionnaire which was also the instrument for gathering primary data. Personal observations were also made to observe the harvesting, skidding, and loading methods of the timber production companies.

The data obtained for different companies were compiled and analyzed with the statistical tools of Microsoft Office (excel). Simple descriptive statistics such as graphs, bar charts, and pie charts were used to compute the different modes of harvesting and load practices by the timber production company contacted.

3. Results

3.1. Number of timbers harvested

Timber production companies in Ghana process round log timbers, harvested from the forest into lumber. The activities of timber production companies in the forest have detrimental effects on the forest. The machines used in the forest for harvesting, loading, and how round logs are skidded from the harvesting point to the loading point affect the forest, especially the juvenile trees. Most of the timber production companies use very old and inefficient machines in their harvesting process in the forest. From the survey, it was observed that most of the contacted timber production companies did not know the number of timbers harvested in a year (Figure 1).

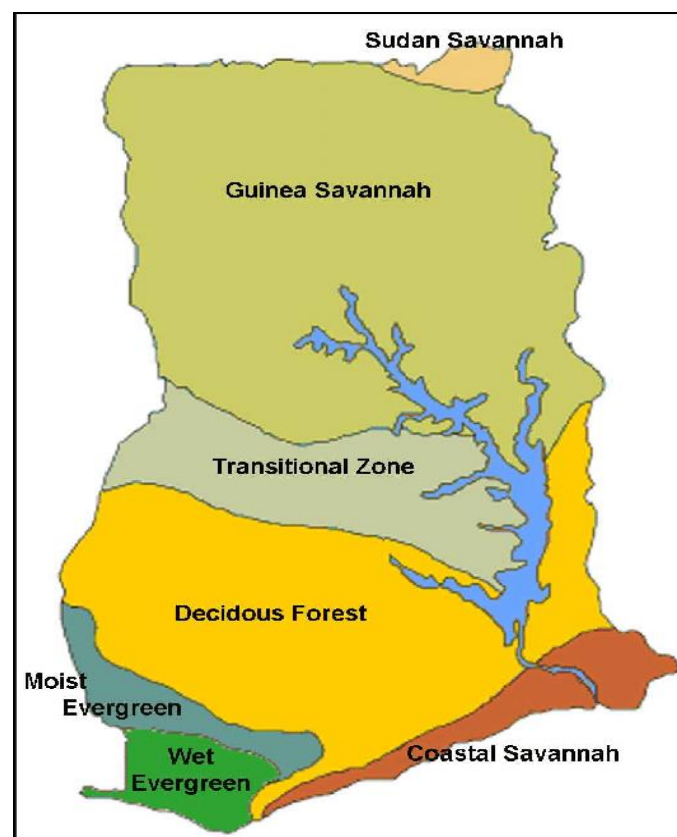


Figure 1. Map of Ghana showing the major ecological zones (Appiah et al., 2014)

It was observed that most of the timber companies did not know the age, weight, and size of the machines they were using in the forest for their operations. Timber production companies did not know the distances covered from the harvesting point to the loading point in their harvesting process in the forest. Due to the low recovery rate of timber production companies in Ghana, timber production companies obtain less lumber for the finished product and need to harvest more timber to meet their yearly target. As the harvesting rate is increased, the ACC also increases and hence increases deforestation in the country. An increase in the installation of sawmills and the generation of Wood waste has direct detrimental effects on the forests in Ghana. Data from the Forestry Commission under the Forest Services Division of Ghana indicate that the level of harvesting over the last 10 years has been exceeding the AAC, indicating that the forest capacity has been surpassed for almost a decade. The official timber harvest data show that in the past decade, recorded forest reserve timber harvest has always been above the on-reserve AAC of 0.5 million m³ except in 2009 when the harvest was equal to the AAC (Pilegaard and Treue, 2008) which is one of the major causes of deforestation in Ghana.

For the timber industry to make improvements in their operations, it is vital to be well equipped in their operations and know the amount they harvest, utilize, and the amount that goes wasted. Timber companies knowing their production levels helps them to know if their production target is met or not. This helps them to formulate policies that help in their smooth operations.

From the study, it was observed that only 10% can quantify the number of timbers they harvest within a year (Figure 2). Most of the timber production companies were not ready to genuinely come out with the number of timbers harvested within a year. Most of the managers contacted in the forest in the course of their operations were not ready to give the exact number of timber they harvest in a year. This behavior has led to a high rate of logging that cannot be documented and this is not pushing the timber production companies to document any of their harvesting processes even if they do that is not the real picture and that is not what is happening on the grounds. Bribes and political influence may be used either to facilitate logging without appropriate permits or to gain access to forests through questionable land concessions.

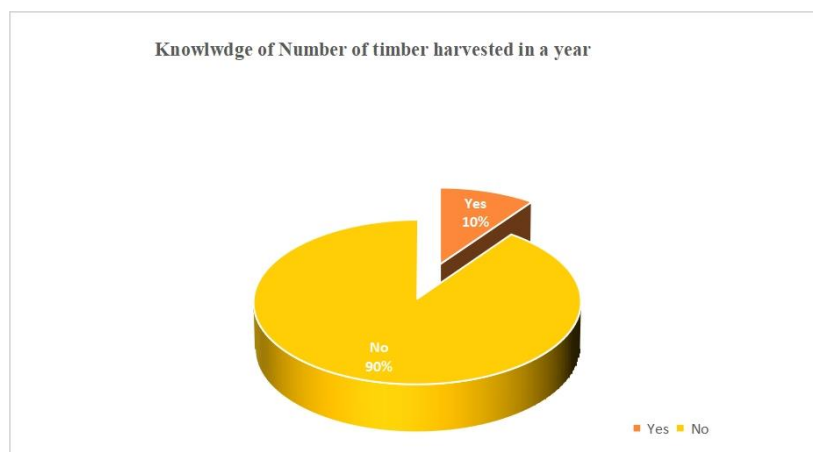


Figure 2. Awareness of the timber production companies on the number of timbers harvested in a year

Some of the supervisors contacted also made it known to me that there is a term called “back door.” This is what most timber production companies do, they bribe the range supervisors and harvest additional wood that is not recorded and not documented, to come out with a genuine number of timber harvested within a year that will be very difficult and most of the people made it clear that no timber production company can genuinely say they do not practice this “back door.” In Ghana Corruption on the side of the officials of the governmental organization who are supposed to protect and preserve the forest, they are rather causing mayhem as far as timber logging is concerned. Top officials of the Ghana Forestry Commission extort money from the timber companies which gives them the green light to harvest timbers that they are not supposed to log. Corruption has been flagged as one of the primary reasons why illegal logging continues in many parts of the world, and why environmental and socially damaging activities by mining, agriculture, and timber companies operating in tropical forest regions are allowed to continue with impunity (Sundström, 2016).

There are several reasons to believe that the forest and forest industry sector may be more susceptible than other sectors to illegalities and corruption. This seems to be the case at least in many tropical and subtropical countries, where forest ecosystems are very complex, access tends to be difficult, and the visibility of illegal operations is lower because of generally insufficient and inefficient monitoring systems and weak media (FAO, 2001).

Reduced impact logging has been tested and applied by other countries on a small scale for more than a decade and many studies have demonstrated that properly planned and supervised operations reduced harvesting costs and destructions as compared to conventional logging in many cases. The cost savings under reduced-impact logging (RIL) result from better planning, better supervisory control, and better utilization of felled timber. Nonetheless, many loggers argue that they cannot afford the adoption of RIL practices (FAO, 2004).

3.2. Machines used

By law, all timber production companies must use a chainsaw for the felling of the timber in the forest. Among the timber companies contacted none use any other device or machine in timber logging apart from the chainsaw. It was a plus for timber production companies. It was observed that using other devices for logging can be very dangerous and deadly. It is also by law by the Ghana Forestry Commission to all timber companies to only use a chainsaw and no other devices in their harvesting process.

It was observed that 14 out of the 20 timber companies contacted use skidders to skid the timber from the logging point to the loading point. Four timber companies use tractors in the same operation and 2 use caterpillars. It was observed that there was a big variation in the sizes of the machines used in the operations. It was also observed that some companies had very large-sized machines as compared to the others. Most of the timber production companies were asked why they were using such machines and whether it was approved by the Ghana Forestry Commission, but they said no, and the range supervisor has been sorted out with the forestry commission. They made it known that it makes their work faster and easier but looking at the way those machines are crashing the juvenile trees it was dreadful. It was also noticed that most of the range supervisors do not monitor the operations of the timber production companies because they have been sorted meaning that they have been given kickbacks and they are to keep quiet in their operation and not to report their deviant operational methods to the officials.

Old-aged machines are inefficient and have low recovery rates. Due to the low recovery of most of the harvesting machines used in the forest, more destruction occurs compared to when using new and efficient harvesting machines. It was observed that all timber production companies do not know the age of the machines that were used in their operations. Most of the timber companies contacted use inefficient machines in their operations in the forest and destroy most of the trees and shrubs in their operations. It was observed that for the use of the machines for timber the companies lack the required skills in their operations. Most of the operators destroy trees and shrubs when skidding and loading timber, while it is possible to use simple loading methods to prevent further destructions. In one scenario that we observed, the tractor operator made so many turns and moved around many times and further cleared a vast area in the loading process. In addition, most of the timber companies contacted use outmoded machines and lack maintenance which makes the operation inefficient and causes more degradation.

Heavy weighted machines when used in the forest make the soil compact which does not support regeneration but rather encourages soil erosion hence forest degradation. From the survey, it was observed that most of the timber production companies do not know the weight of their machines. When asked timber companies if they knew the weight of the machines used in the forest, 3 respondents representing 15% said yes while 17 respondents representing 85% said no, they had no idea about the weight of the machines used in their operations in the forest (Figure 3).

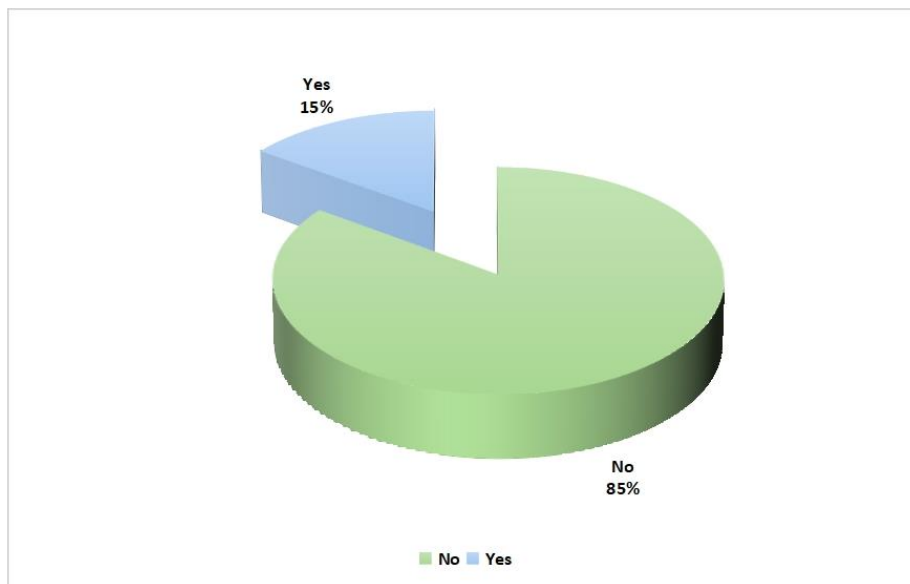


Figure 3. Knowledge of the weight of the machines for carrying the timber

Most of the timber companies have very heavy-duty machines and when working it can be observed that the machines make the soil very compact and make it difficult for regeneration to take place. We observed a field that I was used for over 10 years for loading where there was no regeneration. There was serious erosion in the degraded areas caused by the operations of timber companies. The companies had no information on whether there was a required weight of machines that was approved by the Forestry Commission. Some of the

supervisors said since the logs are heavy, they need to use heavy-duty machines to make their operations easier.

Figure 4 shows the heavy machines and the long distance covered by timber companies from the felling point to the loading points in their operations. It was observed that timber companies are using too heavy weighted machines which makes the soil compact and destroys many juvenile trees and shrubs in the forest. After the land is left bare, it exposes the forest land to erosion and makes regeneration difficult. In the skidding process of the fell timber from the harvesting point to the loading point, it was observed that the timber companies did not plan in the skidding process, and they skid haphazardly over long distances which destroyed tones of juvenile trees and shrubs in the forest. Timber production companies destroy millions of juvenile trees and shrubs in their operation in the forest.



Figure 4. Heavy skidder used to carry timber from the harvesting point to the loading point

According to the manuals of procedure for forest resource management planning in the high forest zone of Ghana, one of the key policies is to ensure that the biological and environmental values of the permanent forest estate are preserved and secondly to sustainably produce forest products that can contribute to domestic and commercial economies, provide funds for forest management and generate revenue for the resource owners. The protection aspect of the policy is lagging due to improper monitoring of forest officials on the operations of timber production companies in the country.

Figure 5 shows how the timber companies clear a wide range of land and use it as a loading station or loading bay. In some of the observations made of the operations of the timber companies, it was observed that most of them clear a very large area of land and use it as their station and loading point. Due to how the soil surface is graded, it makes regeneration is impossible. Since the place has been used as a station that is where all the heavy trucks and machines are parked, and it is hard for regeneration to occur in most of the old loading sites visited due to how destructive nature of the soil. The stations are also used as refill stations or fuels are

refilled and faulty machines are serviced. It was observed that most of the stations have leakages of oils and spills all over the soil and looking at the state of the station it makes it impossible for this regeneration to occur. Looking at the activities of the timber companies it is very fowl, and they are causing more harm than good in the forest and fueling forest degradation with their activities in the forest.



Figure 5. Wide area cleared by timber companies as their loading point (Photo: A legal logging operation in the Sui River Forest Reserve, Photo credit: Nicole Arcilla)

4. Discussion

Timber harvesting is one of the major causes of forest deterioration in tropical forests. Poor and bad timber harvesting methods degrade forest resources and reduce future timber yields, undermining environmental services important for timber producers, local stakeholders, and global society. Negative impacts result from both the direct physical impacts of timber extraction and the indirect effects resulting from building roads and providing access (Snook et al., 2009). Activities of timber production companies in Ghana have detrimental effects on the forest. Machines used by timber companies in the forest affect the forest and deteriorate the forest. From the observation made during the study, many timber companies were not following the required rules and regulations laid down by the Ghana Forestry Commission to govern their process. Looking at the kind of heavy-duty machines that were used in the forest, it is surely known that the Forestry Commission has not approved those machines. It was also observed that the timber production companies do not know the ages, the size, and the weight of the skidders, Caterpillars, and tractors that are used in their operations in the forest.

Due to the inefficiency and the old age of the machines used in the forest, they need to make a lot of runs and turns when skidding and loading. This makes clear a vast area that destroys tons of juveniles of trees and shrubs in the forest (Bertault and Sist, 1997). Because of the heavyweight of the machines used in the forest, when skidding and loading process by the timber production companies, the topsoils, the O and A are horizons carried off leaving the sub-soil or the B-horizon which does not support plant growth which results in the

degradation of the forest. From the observation made, there was an area in the forest where timber harvest had taken place years ago, but the area had not yet recovered. The site has been exposed to soil erosion. The cleared areas that were used as stations, where cars and other machines were parked were also used as service stations when most of the machines in the forest developed mechanical faults. They are also used as a refill station or fuels are refilled. It was observed that most of the stations had leakages of oils and spills all over the soil and looking at the state of the station it makes it impossible for this regeneration to occur. Looking at the activities of the timber companies it is very fowl, and they are causing more harm than good in the forest and fueling forest degradation with their activities in the forest.

According to the manuals of procedure for forest resource management planning in the high forest zone of Ghana, The Timber Unitization Contract (TUC) Area Plan is intended to provide an overview of the operations to be carried out within the TUC over the entire 40-year period (or less, if specifically indicated so) and in more details for the initial 5-year coupe. It is an essential requirement for the TUC application and will be used by the Timber Rights Evaluation Committee as a means of judging the technical competence of the company along with information on the staffing and the equipment operated. The plan is revised every 5 years for the remaining period at the time of preparation of the TUC (5 years) operations plan. Timber production companies do come back to the compartments where harvesting has already taken place, instead of them leaving the compartment to regenerate. These companies do not wait for the regeneration time to be up but find their way out to come back to these compartments by bribing the officials; this impedes regeneration and contributes to deforestation.

There has been an increasing interest at both national and international levels for the new method known as the RIL as an important means for moving towards a sustainable way of forest management that helps manage the high forest deterioration rate. The primary reason for this is that the increased awareness of the negative impacts of ill-planned forestry operations by timber production companies and other stakeholders at the regional, national, and international levels has put much pressure on governments to impose stricter controls on timber harvesting and its methods. In addition, international markets now require timber products from well-managed forests (Antwi-Boasiako and Boadu, 2016).

To facilitate teaching and promoting RIL, the Forestry Training Centre Inc. has prepared a training manual consisting of 17 modules that take the student through the process of RIL step-by-step (Blate et al., 2002; van der Hout, 1999). Introductory courses include all the basic components of RIL in a logical, chronological sequence. This course targets logging supervisors, block inspectors, inventory team leaders, etc. and lasts for 12 days. Decision-makers courses of 3–4 days show all the basics of RIL over a short period with many opportunities for discussions and evaluations. Operators' courses teach harvest planning, felling, skidding, or other heavy equipment operations. Courses briefly touch on other aspects of RIL either preceding or following the particular activity (Klassen et al., 2002). Harvest planning courses are 12 days, while chainsaw and machine operators' courses take 7 days. Issues of occupational health and safety are included in all courses (van Der Hout, 2000). To date, FTCI has organized two courses and one workshop ex-situ, in which 55 persons participated. Participants included field-based operators, field supervisors, concession owners, and representatives of forest administrations of Guyana, Suriname, French Guiana, and Belize. The courses and workshops were well received and led to a growing acceptance and awareness of RIL and demand for training in RIL in the region.

5. Conclusion and recommendations

Tropical deforestation is one of the most serious environmental problems in recent times and has become a major global concern due to the importance of tropical forests in terms of biodiversity conservation and their critical role in global climate change prevention. Ghana's forests are under serious threat due to various human activities that are carried out in and around forests. Several factors are contributing to the high rate of deforestation in Ghana. Less attention is placed on the operations that are carried out by the timber industries when harvesting timber in the forest. Their operations of harvesting, skidding, and loading degrade the forest soil which impedes regeneration and hence contributes to deforestation.

The majority of timber processing companies do not know the size, weight, and age of the machines used for their operations in the forests. Timber production companies use heavier machines that skid the upper part of the soil to the sub-soil and make the soil compact exposing the soil to erosion and hindering regeneration. The old age of the machines used by most of the timber industries makes them inefficient, and their operators make a lot of turns and move around a wide area before the simple loading process is made. In doing so vast areas of land with trees and shrubs are destroyed. Timber industries destroy large chunks of juvenile trees and shrubs when skidding logged timber from the felling stump site to the loading bay. A large land area can be cleared as a loading bay where trees, shrubs, and juveniles are destroyed. When trees are felled, the felling tree causes injury to other nearby trees and shrubs, which sometimes results in the death of the trees. In the process of the research, it was observed that most of the officials who are monitoring the operations of the timber industries in the forest engage in a corrupt act where they take money from the timber industries and stay clients in their monitoring activities. Most of the timber industries do not abide by the rules and regulations that govern their operations in the forest.

To curb this situation, the Ghana Forestry Commission should strengthen the rules and regulations that govern the operations of the timber companies in the forest. Most of the machine operators should be trained on how to use their machines efficiently to avoid deforestation. Ghana Forestry Commission should monitor the size, weight, and age of the skidding and loading machines that are used in their operations to be more efficient and reduce forestation. The Ministry of Land and Natural Resources, with the Ghana Forestry Commission and the security agencies, should help monitor the activities of the timber production companies. Forest officials who stand aloof to the bad operations of the timber production companies should be punished with the timber production companies to serve as deterrents to others.

References

- Affum-Baffoe, K. (2009), "Timber resources outside permanent forest estates of Ghana high forest zone: Status and trends", in: Kyereh, B., Okae K. and Hansen, C.P. (Ed.s), *Strengthening off-Reserve Timber Management in Ghana*, Workshop Proceedings 7, Tropenbos International Ghana, K. S.L., TBI-Ghana and FLD-Denmark.
- Alpert, P. (1993), "Conserving biodiversity in Cameroon", *Ambio*, Vol. 22 No. 1, pp. 44-49.
- Amisah, S., Gyampoh, A.B., Sarfo-Mensah, P. and Quagraine, K.K. (2009), "Livelihood trends in response to climate change in forest fringe communities of the Offin Basin in Ghana", *Journal of Applied Sciences and Environmental Management*, Vol. 13 No. 2, pp.1-11.

- Antwi-Boasiako, C and Boadu, K. B. (2016), "The level of utilization of secondary timber species among furniture producers", *South-east European forestry: SEEFOR*, Vol. 7 No. 1, pp. 39-47.
- Bertault, J. and Sist, P. (1997), "An experimental comparison of different harvesting intensities with reduced impact and conventional logging in East Kalimantan, Indonesia", *Forest Ecology and Management*, Vol. 94 No. 1-3, pp. 209-218.
- Blate, G., Putz, F. and Zweede, J. (2002), *Progress Towards RIL Adoption in Brazil and Bolivia: Driving Forces and Implementation Successes*, RAP Publication, Australia.
- Chazdon, R. (2003), "Tropical Forest recovery: Legacies of human impact and natural disturbances", *Perspectives in Plant Ecology, Evolution and Systematics*, Vol. 6 No. 1-2, pp. 51-71.
- Creswell, J. and Plano, C.V. (2017), *Designing and Conducting Mixed Methods Research*. 2nd ed. Sage Publications, New York, United States.
- Culas, R. (2007), "Deforestation and the environmental Kuznets curve: An institutional perspective", *Ecological Economics*, Vol. 61 No. 2-3, pp. 429-437.
- FAO (2001), "The State of the World Forest", available at: <http://www.fao.org/3/y0900e/y0900e00.htm#topofpage> (accessed on 10 November 2019).
- FAO (2004), "Promoting environmentally sound practices world wide", *Forest Harvesting Bulletin*, Vol. 14. FAO, Rome.
- FAO (2010a), *Food and Agriculture Organization of the United Nations*, FAO, Rome.
- FAO (2010b), *Annual Report*, FAO, Rome.
- FAO (2015), *Global Forest Resources Assessment*, FAO, Rome.
- Fredericksen, T. and Putz, F. (2003), "Silvicultural intensification for tropical forest conservation", *Biodiversity and Conservation*, Vol. 12, pp. 1445-1453.
- Gibbs, H.K., Ruesch, A.S., Achard, F., Clayton, M.K., Holmgren, P., Ramankutty, N. and Foley, J.A. (2010), "Tropical forests were the primary sources of new agricultural land in the 1980s and 1990s", *Proceedings of the National Academy of Sciences*, Vol. 107 No. 38, pp. 16732-16737.
- Gyampoh, B.A. (2011), "Deforestation in Ghana: Government's incentives and policies", available at: <https://www.benjigyampoh.blogspot.com/2011/10/deforestation-in-ghana-governments.html> (accessed 21 August 2021).
- Hawthorne, W.D., Marshall, C.A.M., Juam, M.A. and Agyeman, V.K. (2011), "The impact of logging damage on tropical rainforest, their recovery and regeneration", in: *An Annotated Bibliography*, Oxford Forestry Institute, Oxford, UK. pp. 47-121.
- Idinoba, M., Nkem, J., Kalame, F.B., Tachie-Obeng, E. and Gyampoh, B. (2010), "Dealing with reducing trends in forest ecosystem services through a vulnerability assessment and planned adaptation actions", *African Journal of Environmental Science and Technology*, Vol. 4 No. 7, pp. 419-429.
- Keenan, R.J., Reams, G.A., Achard, F., de Freitas, J.V., Grainger, A. and Lindquist, E. (2015), "Dynamics of global forest area: Results from the FAO global forest resources assessment 2015", *Forest Ecology and Management*, Vol. 352, pp. 9-20.

- Klassen, A.W., Enters, T., Durst, P.B., Applegate, G.B., Kho, P.C.S., Man, G. and Asia-Pacific Forestry Commission. (2002), "Impediments to the Adoption of Reduced Impact Logging in the Indonesian Corporate Sector", available at: <http://www.fao.org/3/ac805e/ac805e0q.htm#bm26> (accessed 30 August 2021).
- Pilegaard, H.C. and Treue, T. (2008), "Assessing illegal logging in Ghana", *International Forestry Review*, Vol. 10 No. 4, pp. 573-590.
- Quacou, I.E. (2016), "Unsustainable management of forests in Ghana from 1900-2010", *International Journal of Environmental: Monitoring and Analysis*, Vol. 4 No. 6, pp. 160-166.
- Quacou, I.E. (2017), "Unsustainable management of forests in Ghana from 1900-2010", *International Journal of Environmental: Monitoring and Analysis*, Vol. 4, No. 6, pp. 160-166.
- Snook, L.K., Sabogal, C., Boscolo, M., Pokorny, B., Quevedo, L., Lentini, M., Colan, V., Medina, R. (2009), "The Adoption of Reduced Impact Logging (RIL) and Other Sustainable Forest Management Practices in Amazonian Forests: A Comparative Study of Timber Harvesting in Brazil, Bolivia and Peru", Buenos Aires, Argentina, XIII World Forestry Congress.
- Sundström, A. (2016), "Understanding illegality and corruption in forest governance", *Journal of Environmental Management*, Vol. 181, pp. 779-790.
- van der Hout, P. (1999), "Reduced Impact Logging in the Tropical Rain Forest of Guyana: Ecological, Economic and Silvicultural Consequences".
- van der Hout, P. (2000), "Testing the applicability of reduced impact logging in greenheart forest in Guyana", *The International Forestry Review*, Vol. 2 No. 1, pp.24-32.
- Vigneri, M. and Kolavalli, S. (2017), "Growth Through Pricing Policy: The Case of Cocoa in Ghana", Background Paper for UNCTAD-FAO Commodities and Development Report.