

Environment, Health and Safety in wood processing at the Akim Oda timber market, Ghana

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Abstract

Wood processing at Akim Oda timber market is the main source of livelihood for most people in Akim Oda. However, the activity is associated with some environmental challenges and also contributes to injuries and other health problems. This study was conducted to assess the Environmental challenges, worker's safety and the attendant health effects in wood processing at Akim Oda Timber Market. Data were collected using interviews, non-participatory observation and focus group discussion from 150 woodworkers who were carpenters, machine operators, wood vendors and potters. The study showed that *Cedrela odorata* was the most common species of wood that was sold and processed at the market while *Lovoa trichiloides* was the least common. The supply of wood to the market was not sustainable, and sustainability could be ensured mainly by tree planting (72%), law enforcement on illegal logging (10%), and education on illegal logging (8%). The major environmental challenges associated with wood processing were the emission of dust (80%), wood waste generation and management (46%), and noise pollution (6%). The wood waste generated comprised sawdust (86%), wood shaving (9%) and wood bark (3%). Although some of this waste was reused, (90%) of the waste were dumped in open areas, (4%) were dumped into water bodies, and (6 %) were burnt. Some of the woodworkers used gloves (32%), Overall (11%), nose mask (58%), safety boot (48%) and helmet (15%) to protect themselves during wood processing, but some of the workers had injuries such as bruises or small cuts (43%), deep cut (30%) and dislocation or fracture (27%). The health effects experienced by the workers in the short term were skin irritation (26%), headache (39%), eye irritation (18%), breathing difficulty (31%), hearing difficulty (5%) and body pains (87%).

Key words: Environment, health, pollution, safety, sustainable, timber

Date of Submission: 20-08-2021

Date of Acceptance: 05-09-2021

I. Introduction

The wood processing industry contributes substantially to the economy of the people of Akim Oda and its environs. Akim Oda, which is in the Birim Central Municipality, falls within the Semi-Deciduous Rainforest Vegetation zone characterized by tall trees. These trees serve as sources of raw materials for the timber industry, which creates employment and income for some of the people in the locality (Ghana Statistical Service, 2014). Timber species are felled in forests and cocoa farms and are sawn into lumber in the form of boards, beams etc. of various sizes. These are transported to the timber market for sale or processing into furniture, doors and other wood products. The World Bank has forecasted that global timber demand is set to quadruple by 2050 (FIM, 2017). As a result, there is growing concern about fulfilling the need for increasing demand for timber products without deteriorating the world's forest resources (Adhikari & Ozarska, 2018). Hence, enhanced insight is required into ways of improving the efficiency of the timber production process, reducing wood wastage and helping the timber sector to address the growing environmental challenges (Eshun et al., 2012).

Several environmental and occupational factors influence a worker's safety behaviours and injury (Thepaksorn et al., 2017). Throughout the various stages of woodworking and manufacturing processes, workers are exposed to airborne dust of different particle sizes, concentrations and compositions (Chamba & Nunes, 2016). The wood processing industry is also associated with a lot of accidents because workers may not follow the Environmental, Health, and Safety Guidelines for manufactured wood products. Environmental, Occupational Health and Safety issues associated with wood products manufacturing primarily include solid waste generation, noise, dust, physical hazards and confined spaces (World Bank Group, 2007).

The environmental impacts of woodworking and wood processing operations, in the form of dust, noise and odour are highly significant (Mayowa et al., 2017). Wood processing industries produce large

volumes of residues that must be utilized, marketed or properly disposed of (Owoyemi et al., 2016). Solid waste from wood processing including sawdust, wood shavings, tree bark and wood off-cuts must be properly managed to reduce their negative effects on the environment.

Workers inhale sawdust which can lead to various forms of respiratory diseases. According to Vallières et al.,(2015), workers in the wood processing industry are at an increased risk of developing adenocarcinoma. The high level of noise from the machine also poses a threat to the health of workers in the wood processing industry and people in the vicinity of the industry. Premature hearing loss, blood pressure alteration, hypertension, severe cardiovascular and non-cardiovascular diseases among industrial workers are well-known outcomes of noise exposure at work (Nawaz & Hasnain, 2013). The World Health Organization (WHO) estimates that 250 million people have hearing loss and two-third of these people are living in developing countries (Vaishali et al., 2011). Most workers in the wood processing industry lack knowledge about Environment, Health and Safety issues, and as a result engage in several activities that destroy the environment and also lead to injuries and health problems at the workplace. This study was therefore designed to assess the environmental challenges, worker's safety measures applied and the attendant health effects of wood processing at Akim Oda 'Timber Market'. The specific objectives were to:

- Identify the species of wood that are sold and processed in the timber market.
- Assess the environmental challenges in the wood processing industry.
- Assess the workplace safety measures in the wood processing operations.
- Determine the short term health effects and injuries due to wood processing operations.

II. Materials and Methods

Study Area

The study was conducted at the timber market in Akim Oda, the capital of the Birim Central Municipal, in the Eastern Region of Ghana. Akim Oda lies between latitudes $05^{\circ} 55' 29.89''$ N and longitude $00^{\circ} 58' 55.78''$ W (Figure 1). The Municipality falls within the Wet Semi-Equatorial Climatic Zone, and therefore experiences a substantial amount of rainfall with monthly mean temperature around 26°C , (ranges between 21°C and 35°C). Because the vegetation zone in Akim Oda and the surrounding villages is a semi-deciduous rainforest with a lot of commercial wood species, it serves as a hub for the supply of various wood products to other parts of Ghana and beyond. Although, there are a number of Sawmills in Akim Oda, which process timber for export. The wood processing industry is dominated by the informal sector most of which operate in the timber market. Activities at the market are wood sales and carpentry which involves wood planing, wood moulding and woodcutting.

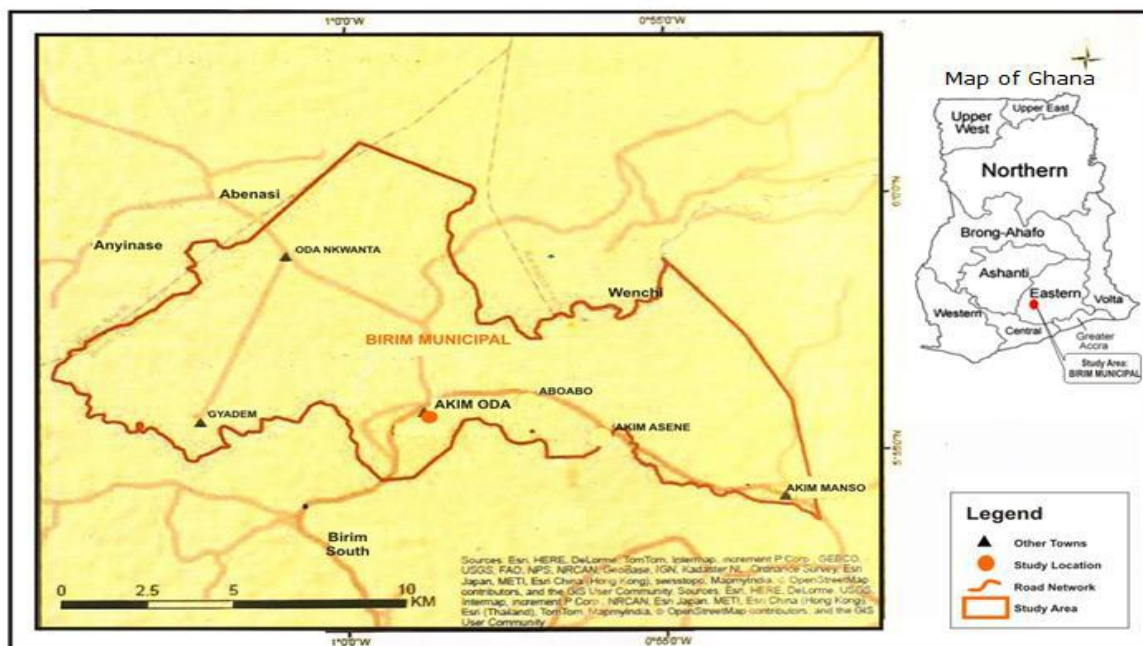


Figure 1: A map of Ghana showing the location of the study area. (Source: Osei-Bonsu, 2017)

Data Collection

Data were collected using interviews, non-participatory observation and focus group discussions between 5th October and 23rd October 2020. One Hundred (100) workers mostly carpenters and machine operators who handled the various aspects of wood processing were randomly sampled and interviewed. A non-participatory observation was also used to investigate the behaviours of respondents during the wood processing operations. Subsequently, two separate focus group discussions were held at the timber market for 30 wood vendors and 20 porters (wood carriers).

Participants were interviewed using an interview schedule with a written list of open-ended and closed ended questions. Issues raised during the interview and focus group discussion include the species of wood sold, sustainability of wood supply, wood waste management, dust and noise production, health effects, safety measures and injuries in wood processing. A list of issues in the interview guide for the assessment of safety practices and health effects were adapted from Lapidus & Waite (2001). The various species of wood at the market were also identified using physical features such as hardness, colour, texture, lustre and odour (Oteng-Amoako, 2006). The identification of wood was further confirmed by the more experienced woodworkers involved in the study. The data collected were statistically analyzed using the SPSS version 16 software package.

III. Results and Discussion

Demographic characteristics

Table 1 shows the demographic characteristics of participants involved in wood processing at the Akim Oda Timber Market. Most (41%) of the respondents were aged 37-47years, followed by 26% aged between 26-36 years, 21% aged 48 years or more, with few (12%) in the 15-25 years bracket. The observation that the majority of the respondents were within (37-47) and (26-36) age brackets suggest that the labour force in the wood processing industry at the timber market is relatively young.

Most of the respondents have had formal education to various levels: at the primary (4%), JHS/MSL (21%), secondary/Technical (71%) and tertiary (1%) levels. Only 3% were illiterate. The high percentage of respondents with secondary education might be due to the technical nature of the job. Most of the participants in this category either attended a technical school or a secondary-technical school where carpentry and joinery were offered as a training programme.

Out of the 100 participants interviewed, most (67%) of them were carpenters with the rest being sawmillers (24%) and designers (9%). Carpentry is the major activity at the timber market, most of the carpenters were involved in the production of doors and other furniture for sale. Participants had worked at the timber market for a different number of years, 23% of them had been on the job for 1-5years, 30% for 6-10 years, 18% for 11-15 years, and 21% for 16 years and above. There was an indication that the worker had a high level of experience because most of them had worked at the timber market for more than five years. It was their view that the longer one worked with a tool or a machine, the more experience he became and the less likely that he would have an injury during work.

Table 1: Demographic characteristics of participants involved in wood processing (n=100)

Variable	Subgroup	Frequency	Percentage
Age	15-25	12	12
	26-36	26	26
	37-47	41	41
	48+	21	21
Level of Education	Illiterate	3	3
	Primary	4	4
	JHS/MSL	21	21
	Sec/Tech	71	71
	Tertiary	1	1
Working experience at timber market	1-5	23	23
	6-10	30	30
	11-15	18	18
	16+	21	21
Expertise	Carpentry	67	67
	Sawmilling	24	24

	Moulding/Designing	9	9
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(Source : Field Work, 2020)

Identified Wood Species

Figure 2 shows the different species of wood sold and processed at the timber market. These include *Swietenia macrophylla* (Mahogany), *Cedrela odorata* (Cedrela), *Piptadeniatrum africanum* (Dahoma), *Nesogordonia papaverifera* (Danta), *Terminalia ivorensis* (Emire), *Petersianthus macrocarpus* (Esia), *Nauclea diderrichii* (Kusia), *Antiaris africana* (Kyenkyen), *Lovoa trichiloides* (African Walnut), *Cleistopholis patens*(Ngonenkyen), *Alstonia boonei* (Nyamedua), *Milicia excelsa* (Odum), *Terminalia superba* (Ofra), *Pycnanthus angolensis* (Otie), *Triplochiton scleroxylon*(Wawa) and *Entandrophragma angolense* (Edinam).

Cedrela odorata (Cedrela) was the most common among the species and can be found outside the forest reserves and in cocoa farms in the area. The trees were sold by farmers to wood vendors to be felled and sawn into lumber which was later transported to the timber market for sale. *Lovoa trichiloides* was very scarce probably because it was mostly found in the forest reserves where one was not permitted to fell timber From.

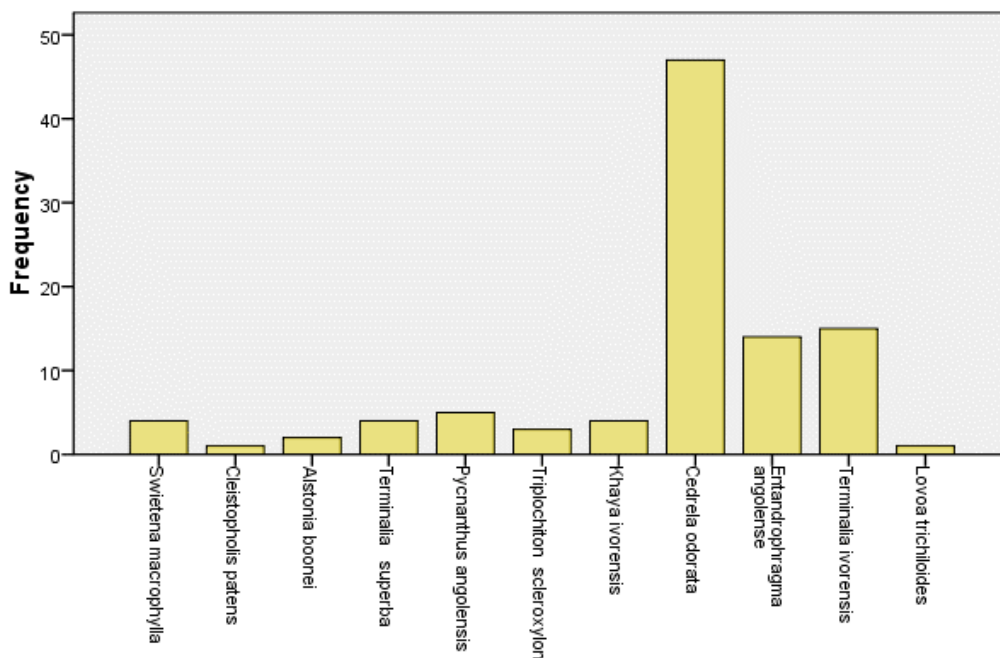


Figure 2: The species of wood sold and processed at the timber market. (Source: Field work, 2020)

Sustainability of wood supply.

According to most (80%) of the participants, the supply of wood to the timber market would not be sustained if some measures are not put in place. This might be due to the high demand for wood products. The demand for wood products is affected by factors including population, levels of urbanization, migration and changing age structures. The population density in any given country, particularly density per unit of a forest, provides a good indication of the pressure on the country's forests. Increases in working-age populations and levels of urbanisation tend to increase the demand for housing and wood products used in construction and furnishing, though urbanisation can also reduce the demand for wood fuel, as access to electricity and alternative forms of heating are generally easier in urban than in rural areas (Brack, 2018). The measures proposed by respondents to ensure the sustainability of wood supply were tree planting (72%), education on illegal logging (15 %) and law enforcement on illegal logging (10%). Others (4%) were of the view that forest concessions must be given to them as a group for logging after which trees will be replanted (Figure 3).

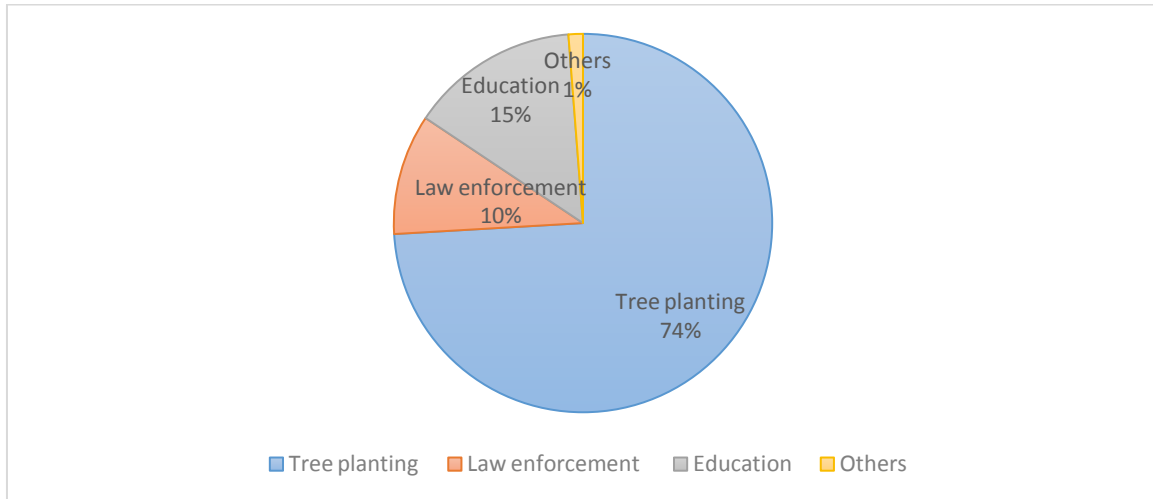


Figure 3: Measures to ensure the sustainable supply of wood.
(Source: Field work, 2020)

Environmental challenges in wood processing

According to the respondents, the wood processing industry at Oda Timber Market posed some Environmental challenges which include dust emission (80%), wood waste generation and management (14 %) and noise pollution (6%). The production of dust which is characteristic of wood processing is a result of wood smoothing or planing, woodcutting and sandpapering using different types of machines which produce some level of noise. The major wood waste generated at the timber market was sawdust (86%), wood shavings (9%), wood bark (3%) and off-cuts (2%) (Table 2). The high quantity of sawdust at the timber market was obvious because sawdust is produced in all aspects of wood processing using the machines.

Although the waste generated was not reduced or recycled, the sawdust, wood shavings and offcuts were reused by some residents in and around Akim Oda. The sawdust was used to fill wetlands or marshy areas in an attempt to reclaim the land or convert it to dry land since parts of the land in Akim Oda are characteristically wet. Some farmers in the area also used the sawdust as mulch. Wood shavings were used as poultry farm beds while the offcuts were used as fuelwood for domestic cooking. It is estimated that 14 million m³ of wood is consumed for energy production in Ghana (Asamoah et al., 2020). Thus, it is very common to see people collecting the wood offcuts at the timber market to be used for domestic cooking.

A substantial amount of the wood waste was disposed of after some have been reused. Results from this study indicated that (90%) of the waste were dumped in open areas, (4%) were dumped into water bodies, and (6 %) were burnt (Table 2). This observation is however different from that of Owoyemi et al.,(2016) in Nigeria where the burning of waste wood was the most common management practice in wood industries.

The burning of wood waste in open areas leads to pollution problems through the release of gases such as sulphur dioxide, nitrogen oxides and carbon monoxide which are harmful to living things.

Disposal of timber products creates various environmental impacts especially in an urban area (Adhikari & Ozarska, 2018). Dumping of sawdust into water bodies could block drainage and cause flooding during the rainy season, which can lead to loss of lives and properties (Elijah & Elegbede, 2015, Karsenty, 2016). Wood waste dumped into water bodies make them toxic and the water bodies get contaminated leading to low species diversity of aquatic organisms in the water body. The waste also clogs the gills of fishes and incidentally, light penetration is reduced which limits the productivity of aquatic plants (Owoyemi et al., 2016).

Table 2: Respondent’s classification of the environmental challenges in the wood processing industry at Akim Oda

Item	Subtype	Percentage of respondents
Major challenge	Dust emission	80
	Noise pollution	6
	Wood waste generation and management	14
Wood waste generated	Saw dust	86
	Wood shavings	9
	Wood bark	9
	Off-cuts	3

Waste disposal method	Open dumping	90
	Dumping into water bodies	4
	Burning in an open space	6

(Source: Field work, 2020)

Health and safety activities in wood processing at Akim Oda Timber Market
Use of Personal Protective Equipment (PPE) by respondents

Wood processing involves different stages which can be connected with workers occupational health and safety (Adhikari & Ozarska, 2018). The use of Personal Protective Equipment, PPE such as safety boots, gloves, goggles, nose masks, overalls and helmet has been recommended to industrial workers to protect them from accidents. Results from this study showed that workers used different Personal Protective Equipment (PPE): gloves (32%), overall (11%), nose mask (58%), safety boot (48%) and helmet (15%) during wood processing (Figure 4). This suggests that the use of the PPE was poor among the woodworkers and this might be due to lack of knowledge on safety issues. This observation is similar to that of a study conducted by Jerie (2012) who found that the use of Personal Protective Equipment was poor and inappropriate in the wood processing industries in Zimbabwe.

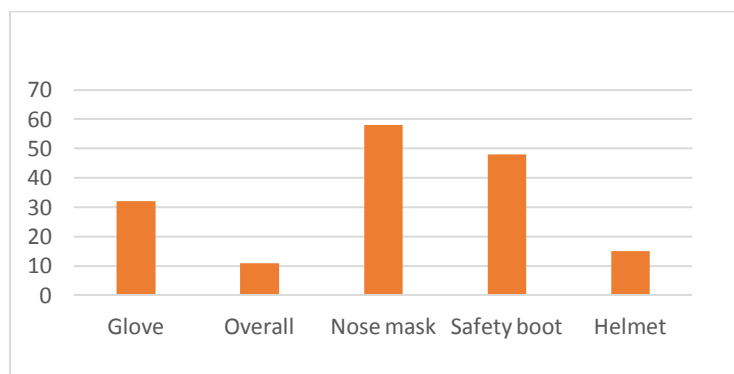


Figure 4: The types of PPE used by wood processing workers at Akim Oda Timber Market
 (Source: Field work, 2020)

Types of injuries and health effects experienced by wood processing workers

Accidents and injuries in the sawmilling industry are caused by exposure to occupational hazards (NSSA, 2009). The findings of this study also indicated that some of the workers have had injuries at the workplace. The major injuries were bruises (43%), cuts (30%) and fractures or dislocations (27%) (Figure 5). This level of injuries among the woodworkers might be due to work behaviours such as responding to telephone calls while working and loss of concentration. The absence of formal training in occupational health and safety might also account for this observation. These findings are similar to those of a study conducted by Ogoti Mong et al., (2017) on wood processing industries in Kenya where a majority of the workers suffered from bruises while a few experienced fractures.

Health effects in wood processing are mostly due to exposure to wood dust and noise. Exposure to wood dust may cause symptoms in the skin, eyes, nose, and airways (Lofstedt et al, 2017). The study also revealed that some of the workers had experienced various health effects in the short term. These were skin irritation (26%), headache (39%), eye irritation (18%), breathing difficulty (31%), hearing difficulty (5%) and body pains (87%) (Figure 5). During wood processing, workers get exposed to sawdust which causes a lot of inconveniences to them. For example, sawdust can irritate the eyes, nose or throat and cause health problems in the short term. The health effects as a result of exposure to sawdust are due to chemicals in the wood or chemical substances in the wood created by bacteria, fungi, (Government of Alberta, Employment and Immigration, 2009). Many wood types like *Piptadeniatrum africanum* contain chemicals that can irritate the eyes, nose and throat, causing shortness of breath, dryness and soreness of the throat, sneezing, tearing and conjunctivitis (inflammation of the mucous membranes of the eye). Wood dust usually collects in the nose, causing sneezing and a runny nose. (Government of Alberta, Employment and Immigration, 2009). Skin irritation is also caused by exposure to the sawdust from woods such as *Petersianthus macrocarpus* and *Cleistopholis patens*. Monoterpenes (compounds found in the essential oils of plants) are irritating to skin and mucous membranes, and can cause both non-allergic and allergic contact dermatitis (Hagstrom et al., 2008), and consequently, woodworkers have a higher risk of developing hand eczema (Meding, 1996). The majority

of the respondents had experienced body pains probably because they had to lift heavy woods from the ground to be processed.

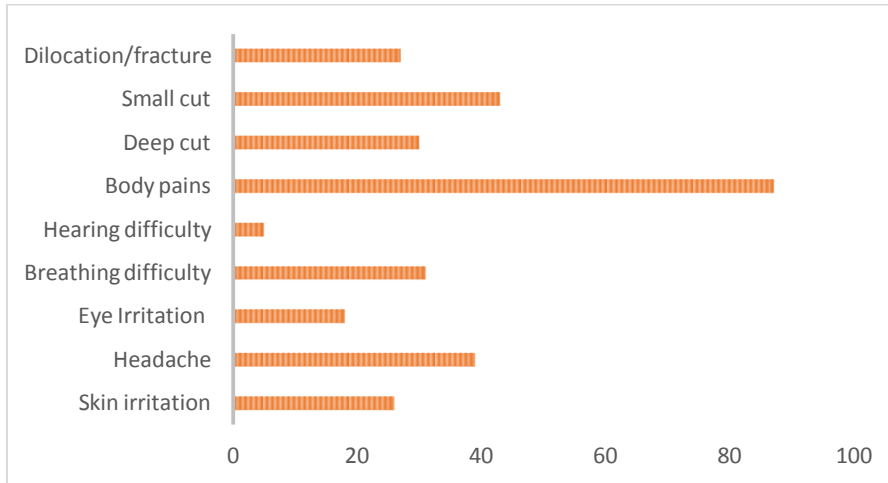


Figure 5: The health effect and types of injuries in wood processing at Akim Oda Timber Market (Source: Field work, 2020)

IV. Focus Group Discussion

The total number of participants (50) at the focus group discussion comprised 30 wood vendors and 20 porters. The high percentage of male in wood vendors and porters is an indication that business in the timber market is dominated by males. The age class mostly represented was 37-47 years category. With regards to education, very few had secondary education but most of the participants had basic education up to Junior High School level. Most of the wood vendors have been trading at the timber market for a longer period (11-15 years), while a majority of the wood porters had worked at the timber market for a relatively short period (1-5 years).

The responses that were obtained during the Focus Group Discussion showed that business activities at the Akim Oda Timber Market provided the main source of livelihood for a lot of families in and around Akim Oda. The porters who were all males had at least basic education but they had no employable skills so they had to resort to this job as a means of survival. Although a porter did not earn enough money in a day, some had been engaged in this for a considerable number of years. Others have also done this job for a shorter period to earn money to further their education or learn a trade. Those who have been engaged in this job for a long time however complained about pains in their waist and neck region. Most of them were aware of the unsustainable nature of their job due to the erratic nature of wood supply, but they preferred staying in that job because they had no alternative. They were however of the view that given the necessary training in utilising the wood waste for other products, and startup capital, they could develop a viable business out of the wood waste.

The wood vendors who were relatively older than the porters had been in this job for a longer period despite the high level of risk associated with the business. It was noted that some of the wood vendors used to be porters but made some savings of their daily earnings to build the financial capital for the wood vending business. They claimed that their business was a risky one because their wood supplies were allegedly been seized by officials of the forestry commission, and they had to pay huge sums of money before they were released to them. According to them, the supply of wood to the timber market was not sustainable. However, they were of the view that the Forestry Commission should give them a timber concession from which to fell trees, after which the trees would be replanted under the supervision of the Forestry Commission.

Table 3: Background information of respondents in the Focus Group Discussion (n=50)

Variable	Subgroup	Frequency	
		Vendors	Porters
Gender	Male	25	20
	Female	5	-
Age (years)	15-25	5	5
	26-36	2	3
	37-47	25	10
	48+	3	2

Educational Level	Illiterate	-	-
	Primary	-	-
	JHS/MSLC	28	18
	Sec/Tech	2	2
	Tertiary	-	-
No of years on the job	1-5		11
	6-10	12	7
	11-15	15	-
	16+	3	2

(Source: Field work, 2020)

V. Conclusion and Recommendations

Conclusion

The following conclusion can be drawn from this study:

1. Different species of wood were identified at the timber market but *Cedrela odorata* was the most common while *Lovoa trichiloides* was the least common or scarce. The supply of wood to the market was not sustainable, and tree planting was the major proposed measure to ensure the sustainability of wood supply.
2. The main environmental challenge faced by workers at the timber market was the emission of dust which constitutes the greatest amount of wood waste generated at the timber market. The wood waste was used for various purposes, the sawdust was used to fill wetlands and as mulch by farmers, wood shavings as poultry farm beds, and offcut as fuel wood for domestic cooking.
3. The use of Personal Protective Equipment (PPE) was very poor among the woodworkers but most of them used nose masks.
4. Woodworkers had also experienced injuries such as small cuts, large cuts and dislocations, and health effects such as skin irritation, eye irritation, breathing difficulty, hearing difficulty and body pains which was the most common health effect.

Recommendation

It is recommended that:

1. Woodworkers be given training on the use of wood waste especially sawdust to make other wood products on a small scale for sale to generate additional income.
2. The local Government should also seek investors to set up a factory in the area that will use the wood waste as a raw material to make wood-based products, biochemicals and bioenergy.
3. Workers should be given periodic training on health and safety to reduce accidents and the hazards of wood processing on their health.

References

- [1]. Ghana Statistical Service, (2014). 2010 Population and Housing Census. District Analytical Report. Birim Central Municipality.
- [2]. FIM (2017). Update on global timber demand. FIM Service Limited, Burford Frihart CR, Birkeland
- [3]. Adhikari, S. and Ozarska, B. (2018). Minimizing environmental impacts of timber products through the production process "From Sawmill to Final Products Environ Syst Res) 7:6 <https://doi.org/10.1186/s40068-018-0109-x>
- [4]. Eshun, J.F., Potting, J. and Leemans, R. (2012). Wood waste minimization in the timber sector of Ghana: a systems approach to reduce environmental impact. J Clean Prod 26:67–78
- [5]. Thepaksorn, P., Siriwong, W., Neitzel, R. L., Somrongthong, R. and Techasrivichien, T. (2017). Relationship Between Noise-Related Risk Perception, Knowledge, and the Use of Hearing Protection Devices Among Para Rubber Wood Sawmill Workers.
- [6]. Chamba, P. and Nunes, E. (2016). Work-related asthma among workers in the wood-processing industry: A review Current Allergy & Clinical Immunology Vol 29, no 2
- [7]. World Bank Group (2007). Environmental, Health, and Safety Guidelines for Sawmilling and Manufactured Wood Products
- [8]. Mayowa, J., Owoyemi, B., Falemara, C. and Ayomide, J. O. (2017). Noise Pollution and Control in Mechanical Processing Wood Industries. Biomedical Statistics and Informatics. 2(2) :54-60. DOI: 10.11648/j.bsi.20170202.13
- [9]. Owoyemi, J. M., Zakariya, H. O. and Elegbede, I. O. (2016). Sustainable wood waste management in Nigeria Environ. Socio.-econ. Stud., 4 (3): 1-9 DOI: 10.1515/environ-2016-0012
- [10]. Vallières, E., Pintos J., Parent, M.E. and Siemiatycki, J. (2015). Occupational exposure to wood dust and risk of lung cancer in two population-based case-control studies in Montreal, Canada. Environ. Health, 14(1), 1. DOI: 10.1186/1476-069X-14-1.
- [11]. Nawaz, S.K. and Hasnain, S. (2013). "Occupational Noise Exposure May Induce Oxidative DNA Damage". Polish Journal on Environmental Studies, 22(5): 1547-1551.
- [12]. Vaishali, P. C., Deepak, S. D. and Chandrakant R. P. (2011). Assessment and Control of Sawmill Noise. International Conference on Chemical, Biological and Environment Sciences (ICCEBS'2011) Bangkok. 299-303pp.
- [13]. Lapidus, R.A. and Waite, M.J. (2001) Safety Management Perception Questionnaire. <http://www.sipeonlinetraining.com/AZResources/Safety%20Management%20Perception%20Survey.pdf>
- [14]. Oteng- Amoako, A. A. (Editor) 2006. 100 tropical African timber trees for Ghana. Tree description and wood identification with notes on distribution, ecology, silviculture, ethnobotany and wood uses. 5p

- [15]. Brack, D. (2018). Sustainable consumption and production of forest products. Background study prepared for the thirteenth session of the United Nations Forum on Forests
- [16]. Asamoah, O., Kuitinen, S., Abrefa Danquah, J., Quartey, E. T., Bamwesigye, D., Boateng, C. M. and Pappinen, A. (2020). Assessing wood waste by timber industry as a contributing factor to deforestation in Ghana. *Forests* 11, 939; doi:10.3390/f11090939
- [17]. Owoyemi, J. M. Zakariya, H. O. . Elegbede, I. O (2016). Sustainable wood waste management in Nigeria *Environ. Socio.-econ. Stud.*, 4, 3: 1-9 DOI: 10.1515/enviro-2016-0012
- [18]. Jerie, S. (2012). Occupational health and safety problems among workers in the wood processing industries in Mutare, Zimbabwe. *Journal of Emerging Trends in Economics and Management Sciences (JETEMS)* 3(3):278-285 (ISSN: 2141-7024
- [19]. Elijah, F.B. and Elegbede, I. (2015). Environmental Sustainability Impact of the Okobaba Sawmill Industry on some biogeochemistry characteristics of the Lagos Lagoon. *Poult. Fish Wildl. Sci.*, 3: 131. DOI: 10.4172/2375-446X.1000131.
- [20]. Karsenty, A. (2016). *The Contemporary Forest Concessions in West and Central Africa: Chronicle of a Foretold Decline?* FAO: Rome, Italy,
- [21]. NSSA. (2009). National report on occupational diseases. <http://www.nssa.org.zw>
- [22]. Ogoti -Mong'are, R., and Mburu, Kiiyukia, C. (2017). Assessment of Occupational Safety and Health Status of Sawmilling Industries in Nakuru County, Kenya *International Journal of Health Sciences*, 5(4): 75-102
- [23]. Lofstedt, H., Hagstrom, K., Bryngelsson, I., Holmstrom, M. and Rask-Andersen, A. (2017). Respiratory symptoms and lung function to wood dust and monoterpene exposure in the wood pellet industry. *Upsala Journal Of Medical Sciences*, 122(2):78–84 <http://dx.doi.org/10.1080/03009734.2017.1285836>
- [24]. Government of Alberta, Employment and Immigration (2009). *Health Effects From Exposure to Wood Dust* Workplace health and safety bulletin Chemical Hazards
- [25]. Hagstrom, K., Axelsson, S., Arvidsson, H., Bryngelsson, I.L., Lundholm, C. and Eriksson K. (2008). Exposure to wood dust, resin acids, and volatile organic compounds during the production of wood pellets. *J Occup Environ Hyg.*;5 :296–304.
- [26]. Meding B, Ahman M. and Karlberg, A.T. (1996). Skin symptoms and contact allergy in woodwork teachers. *Contact Dermatitis.*;3(4):185–90.