The objective of this study is to evaluate the activity of firewood acquisition, using chainsaw, throughout the analysis of the broilers producers from a company located in the West of Paraná - Brazil. It is verified the operating conditions of the chainsaws used and if they are according the safety norms, the individual protective equipment, if the workers receive any training activity and the workers selection use. Based on these issues, it is intended, in this study, to make a diagnostic of the firewood acquisition activity, characterizing the workers. The data collection was carried out by applying a form to 192 of 379 broilers producers that the company has, which represents a significant sampling obtained by statistical methods, which provides a 95% trustful results. The results show that the cut work of the firewood in standardized sizes for use in wood stoves of the aviaries does not provide favorable health working conditions for the workers, because they use the chainsaw without some of the safety equipment required, they do not have any training concerning the operation of the equipment and security, ignoring the obligatory use of Personal Protective Equipment (PPE), being, thus, exposed to the inherent risks of this task, without the adequate protection.

Palavras-chaves: work, chainsaw, firewood, risks
1. Introduction

The Brazilian agriculture and livestock is formed by the farming and livestock exploration. The great part of rural producers is involved in both types of exploitation aiming to diversify the property, i.e., they cultivate plants as well as animals such as birds, cattle and pigs.

Involved in this context it is the Brazilian poultry oriented to the broiler production in aviaries, which is heavily based on the integration system. Integration occurs when the company coordinates the entire production process, providing the chick and all other inputs used in the production and in the technical assistance. This way the company uses indirectly the installations of the rural producer, providing the chick, ration, vaccines, drugs and veterinarian follow-up.

According to Figueiredo et al. (2006), to the integrated producer is responsible to supply all other inputs needed to conduct the poultry activity, such as labor, wood shavings, installations, electrical power, wood for heating and ventilation.

The integration system is used by broilers producers, aiming to diversify the production and consequently raise the incoming of the property (FIGUEIREDO et al., 2006).

Integrating companies have, in their broiler slaughter units, professionals responsible for the hygienic conditions and the security of their employees, which are the workplace safety engineer and technician, who are constantly checking the working conditions that the workers are exposed to combat and avoid illness related to repetitive efforts, ergonomic, extreme temperatures, among others.

However, there is a very important part of this productive chain, called "promotion" (activities developed in the countryside), which has not been assessed related to the hygienic conditions and the workplace safety. It occurs mainly by the lack of information of the workers who, without having the necessary knowledge, work without all the security conditions. There is still a kind of negligence from some companies that use the integration contracts as a way of avoiding the responsibility and the rules from the hygienic and safety conditions at work, they do not offer to these workers technical support able to orient them regarding the importance of this matter.

There is a necessity to make researches that are focused on evaluating the working conditions that the workers involved in the broilers production process are exposed during the performance of their activities.

One of the tasks assumed by the employees during the broiler production process is to cut the wood in standardized sizes; firewood which is used in stoves for heating the birds. This material is obtained by handling a chainsaw which, in many cases, is used without the safety standards necessary for this equipment operation.

With the objective of reducing production costs and encouraging farmers to use a renewable source of energy, the analyzed company installed a sustainability energy program, which has the purpose of having the self-sufficiency in energy to generate heat for the chick in its initial phase of life. The companies make it possible for the broiler farmers through the planting of trees with cutting purposes for the firewood production in their propriety, providing free eucalyptus seedlings.
It can be observed that the worker safety and health are heavily covered in the industrial area (slaughters), however in the country, when fattening and producing the broilers, of this does not occur.

Through a study made by Stave et al. (2007, p. 12), you can identify the importance of the discussion about the risks involving the activities in rural areas where "the results suggested that the intervention methodology, i.e. creating networks for social support, facilitating discussion and reflection with a focus on risk manageability, may have resulted in a desired change in safety activity."

Through this study it was performed an evaluation of this activity made by the workers involved in the broiler production, verifying whether the used chainsaw have the safety standards, identifying the individual protection equipment used and if the workers were trained to operate this equipment.

2. Methodology

The research was performed with the workers involved in the broiler production process in a company located in the West of Paraná - Brazil, which utilizes 379 poultries, totaling 575 aviaries.

Due the population being considered relatively large, taking into consideration that the stalls are distributed in a radius of 100 kilometers from the slaughterhouse, it was necessary to perform a sampling of this population, where it was made the data collection through the form paper with 192 of 379 broilers farmers the company owns. This number represents about 51% of the broilers farmers, being a significant sampling that provided 95% trustful result.

The data needed to conduct this study were obtained through the data collection form paper that was filled by the employees, making possible to characterize the population analyzed and identify the working conditions that they are exposed during the operation with a chainsaw.

It was verified, through the field research, the chainsaw operation conditions used by the workers, identifying the safety items required for this equipment: protection for the right and left hand, manually-operated chain brake, chain catcher and throttle lockout, according to the Brazilian norms related in the Annex I of the Regulatory Standard n° 12. It was also verified if the worker received training operation, transportation, handling and security notions, and if they use individual protection equipment required for the operation such as clothing with anti-cut protection, safety boots with slip-resistant soles and toe steel, a helmet in case of falling objects, eye protection or facial protection, earplug and leather gloves, characterizing and identifying the worker and the workplace conditions that the employees are exposed.

3. Theoretical Foundations

The adoption of modern aviculture technology requires special conditions for the production, requiring high investments in infrastructure. The integrated system by contracts appeared alongside to the great aviculture modernization as changes process in the organizational strategies, spreading rapidly, as Figure 1.
It can be observed that one of the factors that impact directly on the performance of the broiler lot is the environment that the birds are exposed. To maintain a proper ambience, farmers utilize technologies; an example is the use of automatic wood and gas heaters.

According to Funck and Fonseca (2008), to have a good development of the birds, offered by appropriate ambience, the aviaries must be equipped with air conditioning equipment, such as: hoods, nebulizers and heating systems.

Included in the heating process is the use of the chainsaw equipment necessary to the standardized firewood cuts that will be used in the stoves.

The chainsaw is one of the most used machines in rural areas and also one of the most dangerous. This equipment is used for cutting operations as well as processing trees, among other services. According to Cunha et al. (1998, p. 1) the chainsaw is "responsible for serious accidents and occupational diseases, because of the equipment characteristics and condition, the absence of protection measures, ignorance of the risks by the users, the daily exposure time, the procedures and attitudes."

However the use of this equipment freed the forestry workers from the manual cut, facilitating their work which is considered a rudimentary activity (CANTO, 2006).

The chainsaw allows a high individual productivity, with a relatively low investment and it can be used in places which access is hard. Sant’Anna and Malinowki (1999) consider the trees cutting one of the most dangerous activities.

According to Lindroos et al. (2008, p. 2):

Firewood production work is characterized by extremely repetitive operations with simple, but potentially dangerous equipment. Different kinds of equipment cut and split logs in different ways, and thus involves different sorts of risks. Cutting involves risks of cuts from rotating chains or blades, while splitting is associated with risks of crushing injuries from pressing or rotating components as cuts from split edges.

The main risks of the chainsaw operation are associated to injuries made by the blade, noise, vibrations, cutting and falling trees. It is considered so dangerous that deserved an attachment in the Norm Regulation RN 12 – Machinery Equipment of the Brazilian Ministry of Labor.
The work with a chainsaw requires multiple special cares, because of the high rotations of the chain the sharpening process. It must be observed the safety and labor laws, syndicates and other organizations.

Before use the chainsaw for the first time, the worker must request for the authorized seller a demonstration of how to use it in a secure way or to participate in a specific course.

Provide information for the users is correct attitude, because, according to Stave et al. (2007, p. 2), "providing information on risks and their consequences may also be the means to convince participants of the benefits of safety activities".

The employers should offer to their workers a training for the safe usage of the machine, lasting at least 08 (eight) hours, with contents concerning the safe use of chainsaw, according to the instruction manual (ATLAS, 2008).

Agreeing to Thelin (2002, p. 2), "training is probably, key to prevention since knowledge is a prerequisite for understanding regulations and the need of organization and helps to obtain information about suitable technical solutions".

The training availability or the employer responsibility in conducting a training program for their workers, who will use the machinery, must be registered in the equipment guarantee certificate in the specific field, being signed by the consumer.

According to the RN 12 annex 1, since January 1995, the observance of the items related to the vibration and noise, mandatory training for chainsaw operators and labeling, became obligatory.

In comparison with international laws, it can be verified that in Sweden, in accordance with Lindroos et al. (2008, p. 2):

Firewood machines sold in Sweden since 1995 need to comply with European standards (EN 609-1; EN 609-2; EN ISO 11681-1; prEN 1870-6) that are designed to eliminate or reduce risks arising from machine use. Inter alia, the standards prescribe that the machines should be used by a single operator and that they should have safety features such as the wedge splitters’ two-hand controls. Provided that operators comply with these stipulations, the machines are designed to ensure operator safety.

Through a research conducted in the Espírito Santo State with forestry explorers made by Canto (2006), it was found that after analyzing 16.3% of the contracts made with farmers that performed the harvest and transport with their own labor work, it occurred work accidents; mainly for the reason that the workers did not have experience in this activity.

3.1 Safety devices, noise and vibration

The chainsaw, Figure 2, is device used for cutting different kinds of wood. Internal combustion chainsaw is prohibited to operate in closed places or are considered insufficiently ventilated, because the operation of this equipment can cause health injuries to the worker.
For Lindroos et al. (2008, p. 8) "lack of safety features or violations of safety regulations generally increase the probability that an accident will occur".

All equipment has safety devices that help in the accidents prevention, such as the protection for the right and left hand, manually-operated chain brake, chain catcher and throttle lockout. Manually-operated chain brake is the device fired by the operator left hand that stops the chain rotation. Chain catcher is the device that prevents the chain, in case of breakage, hit the operator. Right hand protection, in the case of the chain breakage, it avoid that the chain injures the operator hand, it is a rear protection. The left hand protection prevents the operator left hand involuntary reaches the chain during the operation of the equipment. The throttle lockout prevents unintended acceleration.

Many accidents occur when workers use very old equipment, because according Lindroos et al. (2008, p. 9), "many old machines with possible deficiencies in safety features were in use and many accidents occurred when safety regulations were violated by people failing to work alone."

Excessive noise can damage the employees’ performance, making the concentration on the task hard and even worse communication, because people need to speak loudly and pay more attention to be understood, all of this can increase the psychological tension and the level of attention.

The intense noise tends to undermine tasks that require mental concentration and certain tasks that require attention or speed and accuracy of the movements, and the results tend to worsen after 2 hours of exposure to the noise. Noise also produces annoyance, due a forced crash of the activity or of what people would like be doing, such as chat or sleep, and this causes tensions and headaches (IIDA, 1990, p. 241).

Information about noise and vibrations must be available in catalogues and manufacturers’ instructions manuals containing the level of noise and vibration and the methodology used for benchmarking (ATLAS, 2008).

The RN 15, annex 1, establishes the continuous and intermittent noise levels with the maximum allowable daily exposure. The daily exposure to a continuous noise level of 85 dB(a) is 8 hours, at 90 dB(a) the exposure time is reduced to half, i.e., 4 hours.

The exposure time to the noise should not exceed the limits of tolerance fixed the annex 1 of RN 15. The continuous and intermittent noise levels "must be measured in decibels (dB) with sound pressure level instrument operating in the “A” compensation circuit and the response slow circuit. The measurements must be made close to the worker’s ear". (ATLAS, 2008, p. 139)
It is not allowed the exposure to noise levels above 115 dB(A) for individuals who are not adequately protected.

According to the RN 15, Annex 8, which rules about vibration, activities that expose a worker to vibrations in a local part or of the whole body, may be considered unhealthy by an expertise exam to be held in the workplace.

According to a research held in Brasilia by Fiedler et al. (2006, p. 6) with chainsaw operators and auxiliaries, they were questioned about the external factors that affect their performance, it was obtained the following percentages:

[...] 65.2% of the operators responded that the high temperature was the troublesome over the work, followed by the solar radiation (52.2%) and soot (39.1%). Most of the auxiliaries answered that the noise and the high temperature (48.7%) were the most cumbersome external factors. Other 41% responded it was the solar radiation, 35.9% soot, 10.3% wind and 7.7% lighting and high vibration [...] In this study, the majority of the workers were using an earplug and leather gloves, which greatly reduces the nuisance caused by noise and vibration. But as you can observe, even using these PPE’s, noise and vibration were cited as external factors that affect performance in carrying out the tasks.

In the same survey, concerning to medical licenses, 17 operators (73.9%) responded that they already required license. Among them 11 retreats (64.7%) were due work accident (FIEDLER et al., 2006).

In relation to the body parts that are most affected when the accident occurs, according to Lindroos et al. (2008, p. 7):

Most (71.6%) injuries occurred to upper extremities (fingers, hand, wrist and arm sob). Injuries to fingers alone accounted for 57% of the injuries. Lower extremities (feet, ankles, knee, inner thigh and toes) were injured in 14.7% of the cases, while thorax and spine gebiete (shoulder, hip and back) were injured in 3.4% of the cases.

Base on this facts it is evident the fact that the chainsaw operation is a dangerous work that requires the great attention of the operator, regarding the use of personal protective equipment and the need to follow the safety norms.

3.2 Personal Protective Equipment (PPE ´ s)

To do some activities it is necessary to use personal protective equipment to prevent damage to the worker health such as helmets, eye protection, hearing protector, air cleansing respirator, among others.

Atlas (2008, p. 73) defines the PPE as "any device or product, for individual usage by the worker, intended to protect from susceptible risks that threat the safety and health at work".

All PPE can only be traded and subsequently used by the worker with the Approval Certificate – AC, which is issued by the safety and health competent organ in the Ministry of Labor and Employment.

According to RN 6, cited by Atlas (2008, p. 73), it says that "the company is obligated to provide to the employees, for free, the appropriate PPE considering the risk, in perfect state of preservation and functioning".

The chainsaw operation is a highly stressful activity that exposes the operators in the front work, letting them exposed to a great chance of accidents that can be made softer by the use
of the chainsaw in a proper way as well as the personal protection equipment required (FREITAS, 2008).

The PPE must be provided to the employee with the right size and in a good condition of use, providing the great comfort possible.

In the Annex I of the RN 6, there is a list of personal protection equipment divided into 8 groups: PPE for the head protection; for the eyes and face protection; hearing protection; body protection; protection for the upper members; protection of lower members; the whole body protection and protection against falls with different levels difference.

For doing the chainsaw work it is necessary to use several safety utensils, such as the appropriate clothing that should be practical and not annoying, the clothes should not get stuck easily in the wood and mainly be equipped with anti-cut protection (STIHL, 2007).

Besides the adequate clothing it should be used, according to Stihl (2007, p. 4), the followings PPE’s, "security boot with slip-resistant soles and steel toe; helmet for danger of falling objects; eye protection or facial protector; earplug, e.g. capsules for earing protecting; firm gloves, rather leather gloves."

For Fiedler et al. (2006), when questioning the chainsaw operators about the importance of the PPE’s use, 78.3% of operators replied that they are extremely important and believe that, in diverse situations, they have been saved because they were using the equipment. In this same research, 87.2% of the chainsaw operator’s auxiliaries responded to be very important the use of PPE’s. This research points out the importance given by the workers about the use of PPE’s and the need to keep them in good operation conditions, making the replacements when it is necessary.

### 3.3 The chainsaw handling and the main precautions

Before performing any activity with the equipment, either daily or sporadic use, you should check the machine to be sure it is in perfect working condition.

According to Thelin (2002, p. 2), "there are many reports that existing work protection rules are not observed and that machines and equipment often have serious defects ". The combination of these factors with a length and exhaustive work day contribute to the occurrence of accidents.

The chainsaw operation during the firewood acquisition can be divided basically into three steps: felling, limb removal and bucking.

The felling can be considered one of the most dangerous activities to be performed by the worker, it is usually semi-mechanized with the use of chainsaw and there are usually two workers to perform this task (CANTO, 2006).

According to Thelin (2002, p. 9), "fatal accidents in forestry were completely dominated by those occurring when felling and stacking trees using motor manual equipment (chain saw)."

The limb removal is performed after the felling. In order to do this task it can be used the axe and chainsaw. According to Canto (2006, p. 31), "the operating returns of the limb removal with the chainsaw is 30% faster than with the axe. However, for having a productive limb removal with the chainsaw it is necessary well-trained operators."

The bucking is to cut the tree into different sizes and dimensions depending of the use of that wood.
In order to do this task it is necessary to take some precaution: the worker should never work with this equipment alone; he should stay close enough to call someone in case of emergencies. One of the biggest risks during this work is the kickback, repulsion and traction.

In a kickback the saw is often thrown against the operator and this occurs because the teeth take an oversized bite and temporarily stall, transferring the power from the chain to the saw, which then rotates toward the operator. The danger of causing a fatal injury to the worker may be lessened when the equipment uses the chain brake, because the chain brake is designed to stop the moving chain avoiding larger damage (STIHL, 2007).

Accidents caused by tractor can occur when the operator is sawing with the lower part of the guide bar (from top to down), and the chain lock or find a firm obstacle in the wood, the chainsaw can be attracted with violence forward the trunk. This can be avoided by keeping the guide bar tips in good conditions condition. (STIHL, 2007).

Repulsion occurs when it is sawed with the top side of the guide bar (from down to the top), the chain lock or encounters a firm obstacle, making the chainsaw being repulsed toward the operator causing the kickback. This can be avoided not pressing the top of the guide bar when cutting and not spinning the guide bar during the cutting (STIHL, 2007).

According to a research conducted by Sant’Anna and Malinowki (1999, p. 1), with chainsaw operators, "the felling was the activity that have greatest number of accidents. The parts of the body most affected were the legs (legs and feet) with 37.4% of occurrences ". The main cause of the accident was the lack of attention of the forestry operator, considered the main reason, 35.0% , by the chainsaw operators.

According to research reports conducted in Sweden by forestry workers, AFS (2001) apud Neely and Wilhelmson (2006, p. 8), "in regards to protective gear, slightly less than half of the respondents indicated that they consequently use the complete set of gear the prescribed by government regulations."

Due to the operation with chainsaw be considered an activity that requires intensive care and a large concentration by the worker, it is also verified, in other researches, that the main cause of accidents is also the lack of attention. Fiedler et al. (2006, p. 230), asking the operators regarding the possible causes of work accidents, states that "[...] the vast majority (82.6%) responded that the lack of attention was the main reason. Lack of the use of PPE’s (26.1%), the poor quality of the cutting equipment (21.7%), the poor quality of PPE’s, lack of training (8.7%) and the production pressure (4.4%) [...]."

In a survey conducted with of Swedish workers, Thelin (2002, p. 9), point out that "Eleven fatalities were due to the victims being killed due to the actions of a fellow worker".

In another survey made in the Espírito Santo State, with rural producers, it can be verified throughout the interviews that they considered the most frequent causes of accidents happened due to the lack of attention and inevitable. But, according to Canto (2006, p. 110), "even if there was a high percentage of workers who didn't use PPE’s, mainly in their own forest harvest. This fact highlights about the lack of awareness on the risk of accidents and the most of them could be avoided."

In a study conducted with small Swedish property, where it was done the forestry exploration, Neely and Wilhelmson (2006, p. 8), observe that:

Personal protection use has decreased and non-fatal accidents have increased; while at the same time workers seek medical attention for their injuries more frequently.
Further, these results indicate that better planning during feeling processes may be the key to America the number of accidents for this population.

This discussion establishes that accidents occur because of sum of multiple factors such as lack of attention, the lack of PPE use or even its poor quality, lack of training and pressure. These factors can at any time enormously harm the employees and the company.

4. Discussion of the results

It is verified through this research a new tendency of using new technologies to do the bird heating during the broiler productive process, therefore the farmers are opting for wood combustion heaters, mainly because of "the high prices of the oil tankers, the uncertainties of inner supply, to alleviate the production costs using energy source that is affordable, renewable and it has a low-cost" (SANTOS, 2008, p. 13).

"The use of firewood is unlikely to decrease in the near future, due to rising costs of alternative heating resources (e.g. electricity and petroleum products)" (LINDROOS et. al., 2008, p. 9).

It can be seen in the Chart 1: 31% of broilers producers use firewood Stove as the only source of heating; 53% use wood and gas heating devices and only 16% use as the only heating source the gas.

![Chart 1 – Type of heater used by aviculturists](image)

Taking as base an informal conversation with producers, it is verified that 53% that have wood and gas heater use mainly wood burning as the main heating source., using They only use gas as an add-on. From the 6 broilers lots produced in average per year, only 2 lots need this add-on.

To use the wood as fuel to the stoves, it must be cut in standard sizes of 1.2 m length by 0.35 m diameter, which is done by the use of the chainsaw that is used, in many cases, without following the safety norms required for this equipment operation.

From the producers interviewed that use stoves, 99% use the chainsaw as a primary tool of the firewood standardization and only 1% use the axe, sledgehammer and wedge. The use of the equipment is mainly done during the first 15 days of the broiler production cycle that has 45 days duration in average. The usual frequency of the chainsaw usage is 4 times per lot, during 2 hours and 42 minutes in average per use.
Since the use of this equipment is part of the diverse activities that are executed by the broilers producers and according to Elvik, 2006; Fischer et al., 2005; Weegels and Kanis, 2000 apud Lindroos et al. (2008, p. 2):

The work is assumed to be performed during short, Jan spaced periods of time, which has debatable consequences for accident risks. Low exposure times might imply low accident statistically probabilities, but também been argued to increase rates of accidents per unit time worked due to the lack of practice in handling the seldom-encountered risks.

Beside the factors cited above, the probability of accidents increases when the work is performed with highly dangerous equipment that is the case of the chainsaw, therefore this equipment must be in good conditions and the employee must have been trained to work safely and use personal protective equipment required.

Questioning the broilers workers if they have received training that is required for the chainsaw operation, 100% of the employees have not received any training.

According to Brazilian legislation, especially in the Regulatory Norm 12– Machinery and Equipment, in the Annex I, which deals specifically with chainsaw, it states that manufacturers and importers, through your salespeople will provide training and educational material to chainsaw users and when this responsibility is handed over to the employers, they should provide the training to their workers with a course during at least 8 hours, being everything documented.

Regarding the labor used to carry out the broiler production, it can be observed that 43% of the labor is the rural producer, 14% is the rural producer and an employee and 43% only the employee. From this total, 57% of producers who have employees, 25% work without the proper work documents, i.e., if they suffer any kind of accident they would not be covered by the insurance.

Regarding the safety items required for the chainsaw operating, as can be observed in the Chart 2, the great part of the equipment have them.

![Chart 2 - Chainsaw safety items](image_url)

From the chainsaws observed, 91% had the right-hand protection and 94% the left-hand protection, 75% chain catcher, 82% chain brake and 97% throttle lockout.
It was noticed that the chainsaws that did not have the security items in the equipment were due to the lack of maintenance and generally because of the unawareness about the importance of such accessories.

According to Thelin (2002), many accidents occur because the employee does not follow the safety norms and the equipment and machine are damaged.

Regarding the personal protection equipment required for the chainsaw operation, it can be observed as it is shown in the Chart 3:

![Chart 3 – Personal protection equipment used by broiler workers](chart)

The great part of the workers are unaware about the obligatory use of personal protection equipment, because only 1% uses helmet, 19% eye protection/facial protector, 8% hearing protector, 11% leather gloves, 0% clothes with anti-cut protection, 6% boot with anti-slip soles and steel toe and only 3% uses sunscreen. However none of the equipment checked had the Approval Certificate (A. C.), which according to the Brazilian legislation declares the effectiveness of the PPE.

The accidents incidence can be considered a sign of non-observance of the safety norms during the performance of tasks. In the studied population, about 14% of workers have already suffered some kind of accident operating the chainsaw, being the legs and feet the parts injured.

From these accidents, 9% occurred during felling, 17% during the limb removal and 74% during the bucking.

5. Conclusion

It can be verified that, at the moment, there are conducted many studies and projects related to the increasing of the productivity in the activities developed in aviculture, however there has been done little regarding to the workers safety and health who are involved in this process.

The results show that the firewood cut work in standardized sizes to use in aviaries stoves does not provide favorable working conditions to the workers’ health, because they use the chainsaw without some of the items required for the worker security, they did not received any operation and safety training, they ignore the obligatory use of personal protection equipment, being exposed to the inherent risks of this task, without the adequate protection.
Therefore, taking as base this research, it is noticed that if the workers involved in the firewood cut process don't know how to handle the chainsaw properly, using the personal protection equipment required and the security techniques necessary for the equipment operation, they may suffer several accidents. This will cause a negative impact for the company, mainly by the perception of its members and the society, because a program that should bring benefits may cause several problems.

It is necessary to do an awareness work about the importance to the farmers to perform their activities safely and to provide chainsaw training operation and correct use of PPE’s.

References


