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NOISES IN NATIVE WOOD SAWMILLS IN THE BRAZILIAN AMAZON: A SCOPE REVIEW

RUÍDOS EM SERRARIAS DE MADEIRA NATIVA NA AMAZÔNIA BRASILEIRA: UMA REVISÃO DE ESCOPO

RUIDOS EN ASERRADEROS DE MADERA NATIVA EN LA AMAZONIA BRASILEÑA: UNA REVISIÓN DEL ALCANCE

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Jociane Rosseto de Oliveira Silva[1], Ivan Cleiton de Oliveira Silva[2]

ABSTRACT

Industrial wood processing is carried out in sawmills in the Amazon region, and they play a significant role in the local economy. This study aimed to conduct a systematic literature review to identify studies related to noise in native wood sawmills in the Brazilian Amazon region. The methodology sought to select bibliographic sources related to noise in sawmills operating in the Brazilian Amazon, emphasizing the primary sawing of logs from native forest trees in the Amazon region. The data sources used were Scopus, Google Scholar, and Web of Science. The search keywords used were: noise, sawmill, occupational risk, and Brazilian Amazon. As an eligibility criterion for the review, scientific articles that included the words: noise, sawmill, Brazilian Amazon were accepted. The research was conducted, in an adapted form, according to the methodology recommended by the PRISMA declaration. During the systematic literature review, 509 documents were identified. Applying the filter for scientific articles published in journals, 116 articles remained in the review. After further filtering, considering articles whose research was related to noise in sawmill activities, 19 articles remained. Considering the study region for noise in sawmill activities, three articles were selected. Few studies address occupational risks, ergonomics, and safety of forestry workers in the Brazilian Amazon, in primary and secondary sawmills and processing of timber from native forest trees. Not only in sawmills, but the entire native forestry chain in the Brazilian Amazon has gaps that require further investigation.

Keywords: Occupational Risk. Physical Risk. Logging. Primary Harvesting.

RESUMO

O processamento industrial de madeira é realizado nas serrarias na região amazônica, e desempenham um papel significativo na economia local. O presente trabalho teve como objetivo realizar uma revisão bibliográfica sistemática para identificar estudos relacionados a ruído em serrarias de madeira nativa na região da Amazônia Brasileira. A metodologia visou escolher fontes bibliográficas relacionadas à ruídos em serrarias que operam na

[1] Dr. in Forest Sciences. Universidade do Estado de Mato Grosso. E-mail: jorosseto2@gmail.com
Orcid: 0000-0002-8259-5583 Lattes: 7283366487355218
[2] Dr. in Forest Sciences. Universidade do Estado de Mato Grosso. E-mail: ivanunemataf@unemat.br
Orcid: 0000-0002-4847-020X Lattes: 4808737099066984

Amazônia Brasileira, enfatizando o desdobro primário de toras oriundas de árvores de floresta nativa na região amazônica. As fontes de dados empregadas foram a Scopus, Google Scholar e Web of Science. As palavras-chaves de busca utilizadas foram: ruído, serraria, risco ocupacional e Amazônia brasileira. Como critério de elegibilidade para a revisão, foram aceitos os artigos científicos que incluíam as palavras: ruído, serraria, Amazônia Brasileira. A pesquisa foi realizada, de forma adaptada, conforme metodologia recomendada pela declaração PRISMA. Durante a revisão bibliográfica sistemática foram identificados 509 documentos. Aplicando-se o filtro para artigos científicos publicados em periódicos, permaneceu na revisão 116 artigos. Executando nova filtragem, considerando artigos que a pesquisa estava relacionada com ruído na atividade de serraria, permaneceram 19 artigos. Consideram a região de estudo para ruído na atividade de serraria, foram selecionados três artigos. Poucos são os estudos relacionados aos riscos ocupacionais, ergonomia e segurança do trabalhador florestal na Amazônia Brasileira em serrarias de desdobro primário e secundário e beneficiamento de madeira oriunda de árvores de floresta nativa. Não só nas serrarias, mas toda cadeia florestal de floresta nativa na Amazônia Brasileira possui lacunas que requerem mais investigação.

Palavras-chave: Risco Ocupacional. Risco Físico. Madeireira. Desdobro Primário.

RESUMEN

El procesamiento industrial de la madera se realiza en aserraderos de la Amazonia brasileña, los cuales desempeñan un papel importante en la economía local. Este estudio tuvo como objetivo realizar una revisión sistemática de la literatura para identificar estudios relacionados con el ruido en aserraderos que operan en la Amazonia brasileña, centrándose en el aserrado primario de troncos de árboles nativos de la región. Las fuentes de datos utilizadas fueron Scopus, Google Académico y Web of Science. Las palabras clave de búsqueda fueron: ruido, aserradero, riesgo laboral y Amazonia brasileña. Los artículos científicos que incluían las palabras clave: ruido, aserradero y Amazonia brasileña fueron considerados elegibles para la revisión. La investigación se realizó en un formato adaptado, siguiendo la metodología recomendada por la declaración PRISMA. Durante la revisión sistemática de la literatura, se identificaron 509 documentos. Aplicando el filtro para artículos científicos publicados en revistas, 116 artículos permanecieron en la revisión. Tras un filtro adicional, considerando los artículos cuya investigación se relacionaba con el ruido en las actividades de aserradero, quedaron 19 artículos. Considerando la región de estudio para el ruido en las actividades de aserradero, se seleccionaron tres artículos. Pocos estudios abordan los riesgos laborales, la ergonomía y la seguridad de los trabajadores forestales en la Amazonia brasileña, incluyendo los aserraderos primarios y secundarios, y el procesamiento de madera de árboles nativos. No solo en los aserraderos, sino en toda la cadena forestal nativa de la Amazonia brasileña, existen deficiencias que requieren mayor investigación.

Palabras clave: Riesgo Laboral. Riesgo Físico. Tala. Aserradero Primario.

1 INTRODUCTION

The Amazon biome occupies 49.5% of the National Territory, covering the entire area of the states of Amazonas, Roraima, Acre, and Amapá, almost the entire area of Pará and Rondônia, as well as parts of Mato Grosso, Maranhão, and Tocantins (IBGE, 2019).

The exploitation and industrial processing of wood from the Brazilian Amazon Forest is one of the main economic activities, given the availability of tree species with suitable characteristics for the production of solid wood, making Brazil a world highlight in the forestry scenario for being one of the largest tropical wood producing regions (STRAGLIOTTO *et al.*, 2020).

Industrial wood processing is carried out in sawmills in the Amazon region, which play a significant role in the local economy. They are part of the timber sector, which explores, processes and sells native tropical woods, often of high commercial value, such as ipê, jatobá and maçaranduba.

These are industrial facilities responsible for processing raw wood, usually obtained from native trees, transforming it into planks, boards and other marketable products. They employ thousands of workers, directly and indirectly, and supply wood for the domestic market and for export, and must operate in a legally authorized manner and process wood from forest management and exploitation projects approved by the competent environmental agency.

In sawmills, occupational hazards are permanent. Occupational risks are understood to be any factor present in the work environment that may compromise the health, safety and well-being of the worker, either immediately or over time. These risks are related to the activities performed and the working conditions. The Regulatory Standard – NR 01 (2024) defines occupational risk as: a combination of the probability of injury or health impairment caused by a hazardous event, exposure to a harmful agent or requirement of the work activity and the severity of this injury or health impairment.

According to the Regulatory Standard - NR 09 (2021), occupational risks are classified by groups, namely: physical risks (noise, heat, cold, radiation, vibrations), chemical risks (dust, gases, vapors, fumes, toxic substances), biological risks (viruses, bacteria, fungi, protozoa), ergonomic risks (inadequate posture, repetitive effort, monotony) and mechanical/accidental risks (unprotected machines, falls, electric shock).

Noise is defined as an unwanted sound, having a complexity of vibrations, measured on a logarithmic scale, in a unit called decibel (dB) (IIDA; GUIMARÃES, 2016). The same authors add that the duration of noise causes differentiated effects on human performance and frequent noise/silence changes are more harmful than constant or long-lasting noise.

The most evident consequence of noise is Noise-Induced Hearing Loss (NIHL), which is the decrease in hearing capacity, due to long exposure to noise without proper protection and repeated exposure to excessive noise can lead to permanent hearing loss, and can also cause cardiovascular and digestive problems (NUDELMANN *et al*., 2001; COUTO, 2002).

Noise also decreases the level of attention and increases the individual's reaction time to various stimuli, favoring an increase in the number of errors made and, consequently, in the possibility of work accidents (NUDELMANN *et al*., 2001).

In view of the above, the study of noise in sawmills is essential to protect the health of workers, ensure compliance with legislation, improve the quality of the work environment and avoid labor liabilities and reinforce the image of the industry.

The present study aimed to carry out a systematic literature review to identify studies related to noise in native wood sawmills in the Brazilian Amazon region.

2 METHODOLOGY

A systematic literature review, as well as other types of review studies, is a form of research that uses the literature on a given topic as a source of data, whose investigation provides a summary of the evidence related to a specific intervention strategy, applying explicit and systematized methods of search, critical appraisal and synthesis of the selected information. being useful for integrating information from a set of studies, which may present conflicting and/or coinciding results, as well as identifying themes that need evidence, helping to guide future investigations (LINDE; WILLICH, 2003).

The methodology aims to choose bibliographic sources related to noise in sawmills operating in the Brazilian Amazon, emphasizing the primary splitting of logs from native forest trees in the Amazon region.

In order to achieve these goals, the method known as ProKnow-C, Knowledge Development Process – Constructivist, was chosen, where the process begins with the researcher's interest in a specific theme (ENSSLIN *et al*., 2010).

The data sources used were Scopus, Google Scholar and Web of Science. Scopus is the largest database that brings together abstracts and citations from scientific journals, books and annals of academic events. Google Scholar is an online search tool from Google designed to find academic articles, theses, books, abstracts, and other materials of an academic nature. The Web of Science stands out as an important source of scientific contribution and serves as the basis for the JCR (Journal Citation Report), which is used to determine the impact factor of journals.

The search keywords used were: noise, sawmill, occupational risk and Brazilian Amazon. The Boolean operators AND, OR, NOT and their combinations were used, mixing the search keywords. As an eligibility criterion for the review, scientific articles that included the words: noise, sawmill, Brazilian Amazon were accepted.

With the selection of keywords completed, the search for articles in Portuguese, English and Spanish began, applying the combinations of the chosen keywords. This process was limited to article titles, keywords, and abstracts. The limitation criterion includes the time frame of 15 years (from 2010 to 2025) and the search entry was made through the website of the Coordination for the Improvement of Higher Education Personnel (CAPES) and the Google Scholar platform.

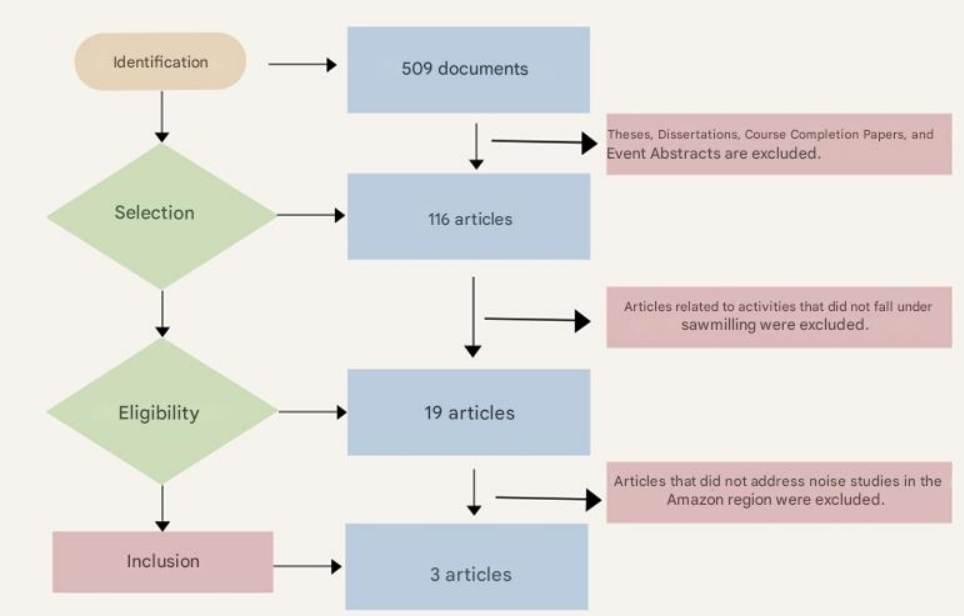
The research was carried out, in an adapted way, according to the methodology recommended by the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) for systematic review studies (LIBERATI *et al.,* 2009).

3 RESULT AND DISCUSSION

During the systematic literature review, 509 documents were identified. Applying the filter to scientific articles published in journals, 116 articles remained in the review. Performing a new filtering, considering articles that the research was related to noise in the sawmill activity, 19 articles remained. Considering the study region for noise in the sawmill activity, three articles were selected (Figure 1).

Figure 1

Flowchart with the stages of identification, selection, eligibility, inclusion of articles



Source: Prepared by the author, adapted according to the PRISMA Flow Diagram.

In order to verify the consistency with the objective of this study, a detailed reading of the three selected articles was carried out, confirming the inclusion criterion in the systematic literature review (Table 1).

Table 1

Selected works for the study

Author	Title	Goal	Periodical/Year
Jesus *et al.*	Evaluation of the work environment in a sawmill in the south of Amapá.	Evaluation of ergonomic factors	Scientific Agriculture in the Semi-Arid Region/2019
Gonçalves *et al.*	Ergonomics and work safety in sawmills: a case study in the Municipality of Aripuanã, Mato Grosso.	Evaluate the ergonomic and safety aspects of the work to which the employees of a sawmill are subjected	Brazilian Journal of Environmental Management and Sustainability/2023
Oliveira *et al*.	Labor and overexploitation in peripheral regions: an analysis based on the logging circuit of the municipality of Nova Esperança do Piriá, Pará, Brazil	Analyze aspects of the overexploitation of the workforce observed in the logging circuit of the municipality of Nova Esperança do Piriá, located in the northeast of Pará	NERA Magazine/2024

In the study of Jesus *etal.*, (2019), the noise levels for each machine were: band saw (93.53 dB(A)), planer (92.15 dB(A)), tracer 1 (92.32 dB(A)), tracer 2 (94.84 dB(A)), multiblade 1 (94.31 dB(A)), multiblade 2 (91 dB(A)). For these noise levels, the maximum exposure time established by NR15 varies from 2h15min to 3h30min, but the working day in this industry was 8 hours.

According to the authors and according to the established standards, the maximum tolerable noise limit for an 8-hour workday is 85 dB(A) and the measured values show that all the machines used by the sawmill exceed this limit, making it not allowed to perform activities in the company during an 8-hour workday without taking measures to mitigate such exposure. They suggest that the first measure to be taken is a 50% reduction in the working day when the established limit is greater than 5 dB(A) and the second measure already adopted by the company, which is the use of hearing protection, which makes the working day can be carried out during the 8 hours, without this harming the hearing of the workers.

In the study by Gonçalves *et al*., (2023) we sought to evaluate ergonomic and safety aspects of the work to which the employees of a sawmill located in the municipality of Aripuanã, in the Northwest of the State of Mato Grosso, Brazil, are subjected. Among the aspects of the work environment, the quality of the work environment was evaluated, taking into account the temperature and noise level existing in the sawmill during its operation.

The authors observed that the noise in the bandsaw, alignment saw and top-saw sectors showed high levels for the employees on duty. From the results, it was found that the

highest noise value was 106.6 dB(A), in the aligner sector, although the other sectors point to lower noise values, even so, they are above the values specified by the regulatory standards (Regulatory Standard NR 15 determines that the worker can be without protection for a maximum of 8 hours, at a noise level of 85 dB(A)).

They also added that practically all wood splitting and processing processes have the presence of noise. In addition to the characteristic of this type of industrial activity, the lack of maintenance and adequate facilities, combined with an inefficient layout, can contribute negatively to the increase in sound pressure levels in the environments of the lumber companies.

Oliveira *et al*., (2024) characterized the subjects, the work and the categories of workers who work in the logging circuit of the study region and observed that the worker in the forestry sector is in constant danger from the primary splitting of the log to its commercialization. The work is heavy and involves a series of ergonomic risks and physical risks to workers, due to aspects such as noise, high temperature and exposure to waste generated by wood sawdust.

The authors observed that workers are exposed to intense noise during the workday, even when wearing hearing protection, and not all workers use this equipment, both in the logging stage and in sawmills. In addition to noise, in sawmills there is also an occupational risk of high temperatures caused by the operation of so many machines gathered in a single space.

For Gonçalves *et al*., (2023), the sawmill evaluated has an unhealthy environment and is subject to the risk of serious work accidents. The observations made by Oliveira *et al*., (2024) mentioning that Amazonian logging, as a space for peripheral development, is operationalized where the minimum amount of capital is invested, sacrificing the maximum social component, which becomes intensely involved in the work, corroborates the panorama of forestry workers in sawmills in the Brazilian Amazon.

There are few studies related to occupational risks, ergonomics and safety of forest workers in the Brazilian Amazon in primary and secondary sawmills and processing of wood from native forest trees. Not only in the sawmills, but the entire forest chain of native forest in the Brazilian Amazon has gaps that require further investigation.

4 FINAL CONSIDERATIONS

The lack of studies related to noise in sawmills is an important gap in the literature and technical-scientific research, which can have significant implications for both workers' health and the efficiency and sustainability of the timber sector.

Sawmills are industrial environments characterized by the intensive use of large machines, such as circular saws, band saws, planers, among others. These machines generate high levels of continuous and intermittent noise, which can easily exceed the safety limits recommended by regulatory agencies, such as NR-15 (Brazilian Regulatory Standard).

Some possible reasons for the paucity of studies include:

1. Research priorities: research in the forestry and timber area focuses on production efficiency, wood quality or processing technologies, leaving aside the occupational and environmental issue of noise.

2. Low visibility of workers: Sawmill workers often belong to informal or poorly regulated sectors, which makes it difficult to implement health and safety policies.

3. Lack of specific policies: in forest production regions far from large centers, inspections on noise in industrial environments are still incipient.

The lack of studies on noise in sawmills not only limits technical knowledge about the problem, but also exposes potentially unhealthy and dangerous working conditions. Encouraging research in this area is essential to know and protect the hearing health of workers, promote the sustainability of the sector and increase productivity with quality.

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