

Changes in the profile of women in mechanized Brazilian sugarcane fields: More educated and less paid

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ABSTRACT

Sugarcane cultivation has been historically present in the national economy, with Brazil being one of the world's largest producers. Women continue to work in the sugarcane sector, traditionally male-dominated. Since 2007, agricultural mechanization in Brazilian sugarcane fields has significantly replaced manual labor with machines. This study investigates the profile of female workers, both in manual and mechanized activities, using data from the Annual Social Information Report (*Relação Anual de Informações Sociais - RAIS*) from 2008 to 2021. The research analyzed the composition of the labor market, wage range, age range, and education level, focusing on two groups: Manual workers and machine operators. The results show the elimination of manual jobs for women, aging of the general workforce, and rejuvenation of operators in the North-Northeast region. Although there is an increase in the education level and wages of machine operators, structural gender inequalities persist, accentuated by regional disparities. The study aims to increase the visibility of women in the sector and understand the structural changes resulting from mechanization.

RESUMO

A cultura da cana-de-açúcar é historicamente presente na economia nacional, com o Brasil sendo um dos maiores produtores mundiais. As mulheres continuam a atuar no setor canavieiro, tradicionalmente masculino. Desde 2007, a mecanização agrícola nos canaviais brasileiros substituiu significativamente o trabalho manual por máquinas. Este estudo investiga o perfil das trabalhadoras, tanto nas atividades manuais quanto mecanizadas, utilizando dados da Relação Anual de Informações Sociais (RAIS) de 2008 a 2021. A pesquisa analisou a composição do mercado de trabalho, faixa salarial, faixa etária e escolaridade, com foco em dois grupos: trabalhadoras manuais e operadoras de máquinas. Os resultados mostram a eliminação de postos de trabalho manuais para mulheres, envelhecimento da força de trabalho geral e rejuvenescimento das operadoras na região Norte-Nordeste. Embora haja aumento na escolaridade e salários das operadoras de máquinas, persistem desigualdades estruturais de gênero, acentuadas pelas disparidades regionais. O estudo busca ampliar a visibilidade das mulheres no setor e compreender as mudanças estruturais decorrentes da mecanização.

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Introduction

The cultivation of sugarcane, present in Brazil for almost 500 years, has established the country as the world's largest producer, hosting about 40% of the global plantation and contributing approximately 2% of the national GDP, reflecting its economic relevance and territorial reach (Food and Agriculture Organization of the United Nations [FAO], 2023; União da Indústria de Cana-de-Açúcar e Bioenergia [UNICA], 2023).

However, the prosperity of this sector is accompanied by relations of domination and exploitation, born from the intersection between capitalism, racism, and patriarchy, which permeate both the urban and rural Brazilian environment. These relations exacerbate gender inequalities, placing women in a position of significant disadvantage, often subjecting them to conditions of extreme poverty (Cardoso & Shimada, 2021).

Even in the face of these adversities, women have always been present in the sugarcane fields, facing intensive and often invisible workdays, subject to overexploitation and low wages (Herrera, 2019; Cruz, 2020). In addition to obligations in formal work, many need to balance multiple socially imposed tasks, especially family care - an even greater challenge for those who are mothers.

Starting in 2007, the Brazilian sugarcane sector went through an intensive process of agricultural mechanization, mainly in the planting and harvesting stages, significantly replacing manual labor with machines, as part of a capitalist strategy to increase productivity and accumulate capital (Baccarin, 2019; Barreto & Thomaz, 2020).

This transformation accentuated gender inequality in a sector historically dominated by men, justified by the exhausting nature of manual labor. Although there has been an increase in female participation in industrial and administrative areas, the presence of women in agricultural activities fell to less than 10% between 2000 and 2016, highlighting the impact of technological changes and the persistence of gender disparities (Gilio, Castro, Rodrigues, & Bacchi, 2019).

In this context of technological transformations and changes in the work environment, it becomes crucial to understand the profile of women who work in the sector. Thus, this research seeks to answer the following question: *How is the profile of the workers involved in work processes, both manual and mechanized, in Brazilian sugarcane fields configured after mechanization?*

Between March and July 2023, secondary data from the Annual Social Information Report (*Relação Anual de Informações Sociais - RAIS*), managed by the federal government and linked to the Ministry of Labor and Employment (*Ministério do Trabalho e Emprego - MTE*), covering the period from 2008 to 2021, were collected to analyze the Brazilian formal

labor market. The research focused on segmentation by gender, age group, educational level, and salary range, selecting six occupations, according to the Brazilian Classification of Occupations (*Classificação Brasileira de Ocupações - CBO*), to represent workers involved in manual or mechanized processes in the sugarcane fields, with a focus on the producing regions of the Center-South and North-Northeast.

The structure of the text, in addition to this introduction, is organized as follows: In the next section, the female workforce in the sugarcane fields between 2008 and 2021 is addressed; then, the salary ranges, education levels, and wages of these workers are analyzed. Finally, the concluding considerations are presented.

The article is expected not only to promote the recognition and visibility of women in the agricultural sector, but also to stimulate the development of new analytical approaches to understand the recent transformations in the sugarcane sector.

Women in the sugarcane fields over the years 2008 to 2021

The underrepresentation of women in the formal labor market, rooted in gender inequalities and the patriarchal structure of capitalist society, is even more pronounced in the rural sector compared to the urban sector (Nogueira & Passos, 2020). With the adoption of more automated methods in agricultural production, significant changes have occurred in the composition of the workforce, highlighting the need to analyze female participation in the sugarcane sector.

Mechanization reduced the demand for manual labor and increased employment in machine-operating roles. In 2008, in the Central-South region, 99.40% of female workers were involved in manual activities, while only 0.60% worked in mechanization. In 2021, the proportion changed to 86.70% in manual work and 13.30% in mechanization.

In the North-Northeast, the predominance of manual labor was even greater in 2008, with 99.80% of the workers in manual activities and only 0.20% in mechanization. In 2021, the proportion changed to 94.79% for manual work and 5.21% for mechanization, and although it shows a slight change, it still reveals the significant predominance of manual labor in the region.

This disparity in the mechanization process between the regions of Brazil, with the Central-South region leading the adoption of machinery, resulted in a significant increase in unemployment in the sector, particularly in the less mechanized areas. Despite a growth of more than 600% in percentage terms in female labor, fewer than 3,000 women operated machines in the sugarcane fields, compared to more than 80,000 men in the same role (Lima & Carvalho, 2023). This data illustrates how occupations in the sugarcane sector became increasingly restricted to the male gender during the period analyzed.

The data presented in Table 1 indicate a significant reduction in the presence of women in the sugarcane fields. The number of female workers employed fell from 77,500 in 2008 to 22,356 in 2021 - a decrease of nearly 72%. In contrast, according to Lima and Carvalho (2023), the reduction among male workers was proportionally smaller, reaching 56%.

Table 1.

Female workforce in the agricultural sector by region of the Brazilian sugar-alcohol industry from 2008 to 2021.

YEAR	MANUAL WORK			MECHANIZED WORK		
	N/N	C/S	TOTAL	N/N	C/S	TOTAL
2008	4,910	72,147	77,057	10	433	443
2009	4,289	60,973	65,262	8	765	773
2010	5,210	59,303	64,513	12	1,024	1,036
2011	5,983	58,098	64,081	55	1,444	1,499
2012	5,199	53,879	59,078	37	2,098	2,135
2013	4,784	46,261	51,045	75	3,003	3,078
2014	3,977	36,050	40,027	33	3,280	3,313
2015	3,258	27,272	30,530	71	3,007	3,078
2016	3,014	21,758	24,772	48	2,939	2,987
2017	3,026	18,769	21,795	55	2,697	2,752
2018	2,307	18,275	20,582	80	2,584	2,664
2019	2,210	17,839	20,049	103	2,384	2,487
2020	1,933	16,069	18,002	69	2,331	2,400
2021	2,474	17,129	19,603	136	2,617	2,753

Source: Prepared by the author based on RAIS data, 2023.

In this context, it is important to ask: Who are the women who continue working in this sector? Next, an analysis of this group will be conducted, considering aspects such as age group, level of education, and remuneration.

Age range of women involved in manual labor

In the Central-South and North-Northeast regions, most women involved in manual labor are in the 40 to 49-year age group. In the Central-South, 56% of female manual workers are 40 years or older, and in the North-Northeast, this percentage is even higher, reaching 59%. The study by Lima and Carvalho (2023), when analyzing the sector as a whole, confirms this trend: From the year 2014, there was an increase in the number of workers older than 29 years, especially in the 40 to 49-year age group.

The aging of the workforce in the sugarcane sector, observed by Baccarin (2019), can be explained by a combination of factors such as the increase in education levels among the young population and the expansion of opportunities in other sectors of the economy. This scenario, characterized by socioeconomic improvements and greater labor market dynamism, has discouraged the entry of young people into the agricultural sector, postponing generational succession - a traditional characteristic of the sugarcane sector (Santos, 2013).

On the other hand, in mechanized work, the predominant age groups differ between regions. In the Central-South, 56% of workers in mechanized roles are up to 39 years old, while in the North-Northeast, this number is even more striking: 77%. These regional differences highlight distinct age dynamics within the sector - manual activities are associated with an older workforce, while mechanized ones have a younger profile, especially in the North-Northeast.

Schooling

When examining schooling in the Brazilian agricultural labor market, it is observed that workers in this sector still have the lowest educational levels in the country. However, data indicate a general increase in the education of female workers, especially among machine operators, who have higher education levels than manual workers. In the Center-South region, 72% of women in mechanized roles have completed high school or higher, while 64% of manual laborers have only completed middle school or higher.

This advancement in educational qualification reflects significant social changes, especially during the governments of Lula and Dilma, who promoted investments in the democratization of access to education (Marques, 2018). Despite this, educational improvements are not distributed uniformly across the country.

In the North-Northeast, although there is progress in the mechanized sector, most female workers still have lower educational levels. While 84% of machine operators have completed high school or higher, 72% of manual workers have only completed elementary school I. These regional disparities show that although there have been advances in schooling in Brazil, educational inequalities persist between regions.

In this context, the Labor Market Segmentation Theory, as discussed by Oliveira and Piccinini (2011), distinguishes two segments: The primary (or central), associated with more stable jobs, higher wages, and greater qualification requirements; and the secondary (or peripheral), characterized by low wages, low educational requirements, lack of stability, and scarce opportunities for professional advancement.

The persistence of women, especially manual workers, in the secondary sector contributes to the reproduction of structural inequalities, making access to more valued occupations difficult. In this way, educational disparities, combined with labor market

segmentation, reinforce historical barriers that marginalize women in positions of greater vulnerability.

Remuneration

The increase in the average salary in rural areas, over the analyzed period, was driven both by the expansion of the sector and by the rapid technological transformation, which required more qualified and, consequently, better-paid workers. However, the question arises: Did female sugarcane workers also experience this wage increase?

Mechanization brought some wage improvements for women workers, especially in the Center-South, where the higher wage brackets remained stable, despite a reduction in the highest earnings. In this region, 82% of manual workers earn between 1.01 and 4 minimum wages, while 88% of workers in mechanized roles fall within the range of 1.51 to 4 minimum wages. However, over time, a decline in women's wages has been observed, as the proportion of those earning up to 1.5 minimum wages increased from 55% in 2008 to 73% in 2021.

In the North-Northeast, wages continue to be significantly lower. In the region, 76% of manual workers earn between 1.01 and 2 minimum wages, while 51% of mechanized workers earn between 1.51 and 4 minimum wages. The wage range above 4 minimum wages has never been recorded, which strongly contrasts with the reality of the Central-South. These regional disparities highlight the persistent wage inequality between regions, a characteristic of the sector, as noted by Lima (2021).

Final Considerations

The entry of women into the sugarcane labor market is marked by significant gender inequality and low social valuation, reflecting the structural disparities of the sector. With technological advancement, especially mechanization, there has been a reshaping of the work profile and conditions, increasing the demand for higher qualifications and, to some extent, improving the educational levels of female workers. However, these improvements have not translated into a proportional increase in wages.

Working conditions continue to reflect structural inequalities, manifested by regional disparities in terms of age, education, and wages. These disparities highlight not only historical and social inequalities but also the specific impacts of regional dynamics on the experience of female workers.

When analyzing the dynamics of the formal female workforce in the Brazilian sugarcane sector between 2008 and 2021, a significant increase in unemployment in the sector is evident, a phenomenon that reflects the technological and automation transformations that occurred in the production processes.

Particularly in the North-Northeast region, female workers continue to receive wages below the national average, which reinforces the persistence of regional inequality. Technological modernization, although it brings productivity gains, also raises uncertainties regarding the future of these women, since the advancement of machines tends to impact female labor more severely.

Finally, it is important to highlight the gaps that remain in the research. Future studies can contribute to a deeper understanding of this scenario by investigating the career paths and adaptation mechanisms of workers excluded from the productive process in sugarcane agriculture.

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