Tridimensional sustainability of cashew nuts processing industry in Mozambique

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Abstract

Cashew industry in Mozambique plays an important role in adding value to cashew nuts, generating foreign exchange and jobs. However, little is known about its sustainability. The objective of this study was to assess the sustainability of Mozambican cashew nuts processing industry, in an integrated approach of the environmental, economic and social dimensions.

A tridimensional sustainability study was conducted across six raw cashew nut (RCN) processing factories. Structured interviews, in a multiple case study strategy, were implemented with 385 workers, selected through simple random probabilistic sampling to ensure unbiased representation.

Data were processed and analysed based on descriptive statistics using SPSS version 22.0 statistical package. Frequency distribution, average and median analysis was determined using Excel spread sheet and SPSS. Sustainability Grid was used to establish relative positioning of each company.

The results indicate that 69.9% of the workers in the cashew industry are women. The average age of workers in the cashew industry was 33.92 ± 9.08 years, ranging from 20 to 65 years and a median of 32.25 years. Workers reported varying levels of education background, ranging from literate with 0.5 percent to higher education with 3.1 percent, and most workers have attended secondary education in the interval of 8 to 10^{th} grade, 32 percent attended.

The study revealed heterogeneity in sustainability practices among factories. For the environmental dimension, there were concerns on the management of the cashew nutshell. While in the economic dimension, irregular availability of cashew nuts, high interest rates and unpredictable prices of cashew kernel on the global market were reported. In the social dimension, job satisfaction was moderate, but concerns were raised due to lack of support to proceed with formal education. There are several external factors that impose vital challenges, including illegal foreign RCN buyers.

Although many similarities with cashew industries from other African countries, there is a need for integrated sustainability policies in cashew processing industry to ensure balanced progress across all three dimensions, specifically on improving the management of cashew nut shells, establishing competitive interest rates, supporting workers on formal training and reinforcing the cashew actors registration regulation to discourage illegal RCN buyers.

KEY WORDS

1. Cashew industry, 2. Social, economic and environmental sustainability, 3. Agro processing, 4. Sustainability grid, 5. Socio-economic profile

1. Introduction

Cashew (*Anacardium occidentale*) is native to Brasil [1] and is one of the most consumed nuts around the world, with a global market size that is expected to reach USD 11.67 billion by 2033, growing at a Compound Annual Growth Rate (CAGR) of 4.6% over the forecast period (2025-33) [2]. Cashew plays an important role in Mozambique's economy, providing the primary source of income for a significant portion of smallholder farmers. It is estimated that than 1 million rural families are involved in cashew production and rely on the cashew business as a source of income, generating economic activity for small, medium, and large formal and informal enterprises [3].

Over the past five years, Mozambique has traded an annual average of 146,000 tons of cashew nuts, of which approximately 60,000 tons are processed by the domestic industry, approximately 50,000 tons are exported raw, and the remaining 36,000 are used in the informal sector and for domestic consumption. Exports of raw cashew nuts and kernels have generated

revenues ranging from US$80 to US$100 million per year [4]. From 2011 to 2020, cashews contributed, on average, approximately six percent of total agricultural exports [5].

In 2017, Mozambique had 15 primary cashew processing factories, with an installed capacity of approximately 100,000 tons/year and an operational capacity of approximately 60,000 tons/year [6]. At that time, a secondary kernel processing industry was emerging. It consisted of 10 small factories with processing capacity of 3,000 tons/year aiming to supply the domestic and the USA market. Together, primary and secondary industrial units employed approximately 17,000 workers, the majority of which being women [7], [8].

Since its inception in 1940, the cashew industry has played an important role in Mozambique's socioeconomic development, notably through the creation of myriad of jobs, income generation, and foreign exchange. Due to its importance, several studies have been conducted on the cashew industry and respective market system [9], [10], [11] including the those by Nitidae (2020) and Namburete (2022) on the competitiveness of the cashew industry ([12], [13]). However, information on the sustainability of the cashew industry is lacking. In Mozambique such socioeconomic and environmental information is critical to assess the ability of industries to meet current and future requirements in different perspectives. Furthermore, understanding the holistic complexity of three dimensions of sustainability on their interrelationships with external factors, provides clarity to the dynamics of the cashew industry and its potential sustainable survival in a highly competitive and changing global environment.

This study is targeted factory workers, shareholders and managers of cashew processing companies in Mozambique and aimed to generate information that will help to improve corporates´ performance regarding social, economic, and environmental sustainability indicators while pursuing corporate profit objectives.

2. Methods

2.1. Study location, sampling, and data collection technique

The study was designed comprise both descriptive [14] and quantitative data collection approaches [15] associated with the three analytical dimensions in cashew processing industries distributed in Gaza, Nampula, and Cabo Delgado provinces.

A questionnaire was developed and tested, through interviews [16] to a sample of 50 workers from the Condor Nuts industry, a subsample that represents about 12% of the final sample ([17], [18]) and adjustments to the questionnaire were made [19]. The questions were either

open-ended or closed-ended [20] and were administered through the interview technique [21]. Probability sampling was used [22] in a target population of 1,728 workers in the six operational raw cashew nut processing factories. From these, a sample of 385 workers was determined appropriately [23]. The sample size was defined for each factory, and simple and systematic random sampling was carried out using the employee list and the random number table generated through Excel ([24], [25]). The distribution of sub-sampling units by cashew processing plant is shown in Table 1.

Table 1. Sample size and distribution per cashew nut processing factory in Mozambique, in 2023

Factory	Province	Installed capacity (Tons)	Raw cashew nuts - season 2021/2022 (Tons)	Number of workers	Relative Frequency	Sample size
A	Gaza	8,000	3,690	560	0.4382	125
B	Nampula	10,000	3,700	210	0.1643	47
C	Nampula	15,000	12,952	215	0.1682	48
D	Nampula	10,000	6,802	220	0.1721	49
E	Nampula	150	80	73	0.0571	16
F	Cabo Delgado	6,000	4,000	450	0.3521	100
Total	**-**	**43,150**	**27,224**	**1,278**	**1.00**	**385**

Source: Authors

2.2. Collection of sociodemographic and sustainability data

For the sustainability assessment of each cashew nut processing factory, the Corporate Sustainability Grid (CSG) model, proposed by [26].

The CSG model comprises 43 indicators: 16 environmental, 14 economic and 13 social. In this study an additional indicator of CO_2 deployed by factories to the environment was analysed, proposed by [27], therefore, 17 environmental indicators were considered. For each indicator three performance levels were used and one value for each level: (1) lower performance (meaning that the factory has insufficient performance in the indicator analyzed), the value assigned is 1 (one); (2) intermediate performance (the factory displays median performance) and has the performance value assigned 2 (mandatory); and (3) higher performance (the factory has a higher performance in the analyzed indicator) and the value 3 (three) is assigned for this performance.

Each factory analysed was assigned a value corresponding to its performance in the variable under study according to the procedures developed by [26].

2.3. Collection of external factors data

External factors in this study refers to all impacting elements not covered by the presented analytical model but used for factory comparison purpose. These can be endogenous and exogenous elements to the processing factories if they can differentiate them from one another in terms of sustainability. The main assumption is that the cashew processing industry in Mozambique is heterogeneous in terms of technology, layout, and size [12]. Differentiation [28] is a strategic market positioning approach, as it offers a better way to identify market opportunities and adjust marketing mixes to each target segment, focusing efforts to better meet the demand within a targeted approach. Diversification therefore includes increases in the variety of final products manufactured, increases in vertical integration, and increases in the number of production areas in which a firm operates [29]. One of the critical factors for the operationalization of cashew processing industries is access to credit [30]. Access to credit is a key constraint on competitiveness and determines a company's ability to respond to changing market trends [31]. Therefore, interviews´ based comparative analysis was also conducted on how easy with which company can finance initial costs and processing improvements through financial resources from public and private banking institutions.

2.4. Data analysis method

Data analysis was performed using descriptive statistics [14], [15]: Appropriate frequency, percentages, means, median, and mode were considered. Data were processed using frequency and mode statistics in the SPSS 22 (Statistical Package for the Social Sciences Statistics, version 22) statistical package from IBM (International Business Machines) [32]. Sustainability was determined by the aggregated assessment of the indicators of the three dimensions analyzed. For each dimension, the results were presented in three stages: the first consisted of a summary of the results obtained by the six companies studied in relation to the indicators; the second consisted of the analytical presentation regarding the results obtained by each of the companies; and the third consisted of the calculation of the results obtained by the six companies in relation to the Partial Sustainability Score (PSS) considering the indicators and their respective model weights.

3. Results and Discussion

3.1. Sociodemographic Data of Cashew Processing Factories Employees

The sociodemographic data of the six factories studied, with a total of 385 respondents, indicate that 69.9 percent are women and 30.1 percent are men. The percentage of women in the cashew industry in this study is relatively higher than the 57% reported by [10]. Despite this difference, the numbers highlight the importance of women in the cashew processing industry. The predominance of women in the cashew industry was also mentioned in Burkina Faso, in a processing unit where 90 percent of the 250 workers are women [33]. In India, more than 90 percent of workers in cashew processing are women [34]. Of all the industries covered in the present study, only at ADPP Cashew Center, more men than women were found. Figure 1 illustrates the number of men and women by industry.

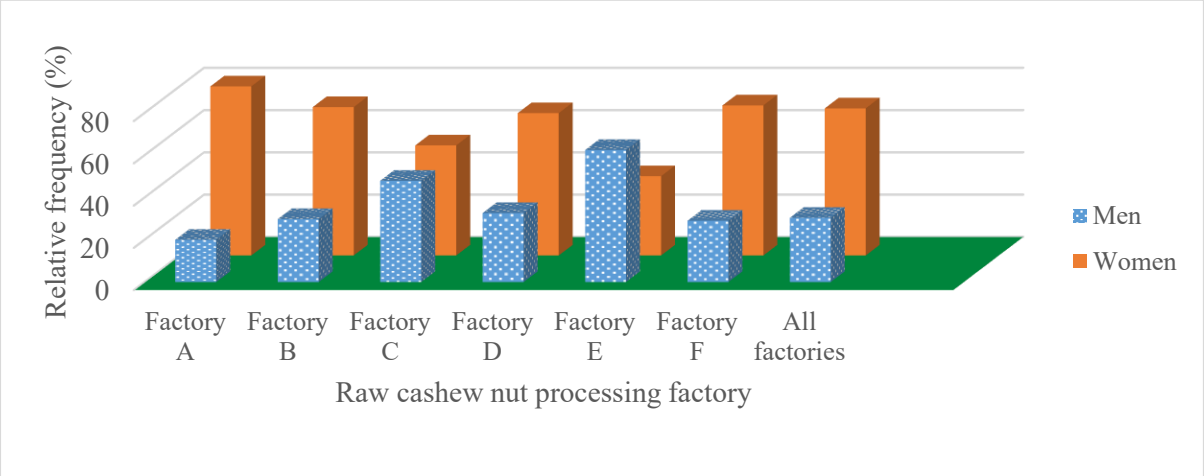

Figure 1. Distribution of manpower (men and women) in the cashew industry in Mozambique, 2023.
Source: Authors

The mean age of workers in the cashew industry was 33.92 ± 9.08 years, with extremes of 20 and 65 years and a median of 32.25 years. The age group of 22 to 42 years was the most represented at 81.30 percent. These data are similar to those obtained by [33], with a slight difference in relation to the lower limit of 18 years and the age group with the most workers of 30 to 39 years at 38.39 percent. Figure 4 displays the age frequency of workers in the cashew industry.

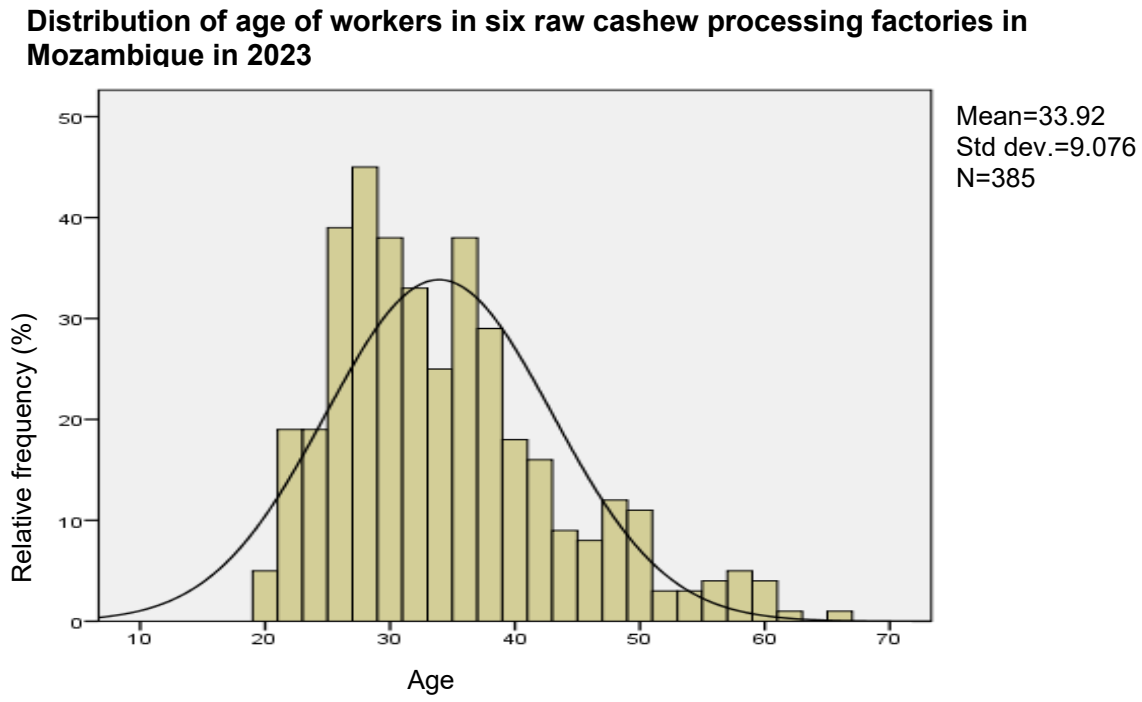

Figure 2. Distribution of age of workers in six raw cashew processing factories in Mozambique in 2023
Source: Authors

The cashew industry employs people with varying levels of education, including those who were unable to attend any educational institution. However, most workers (32.2%), attended secondary cycle 1 school (grade 8 to 10), followed by workers who attended secondary school secondary cycle 2 (grade 11 to 12), at 30.4 percent. Workers who attended primary cycle 1 and 2 school (11.7 and 11.4 percent) respectively were in third and fourth position, followed by workers who did not attend any formal educational institution, at 10.6 percent. Workers who attended higher education (3.1 percent), and finally, literate workers (0.5 percent). In Mozambique, the number of illiterate workers in the cashew industry, is by far lower when compared to 72.3 percent, as reported by [33] in a cashew processing unit in Burkina Faso. Figure 3 illustrates the educational level of cashew industry workers.

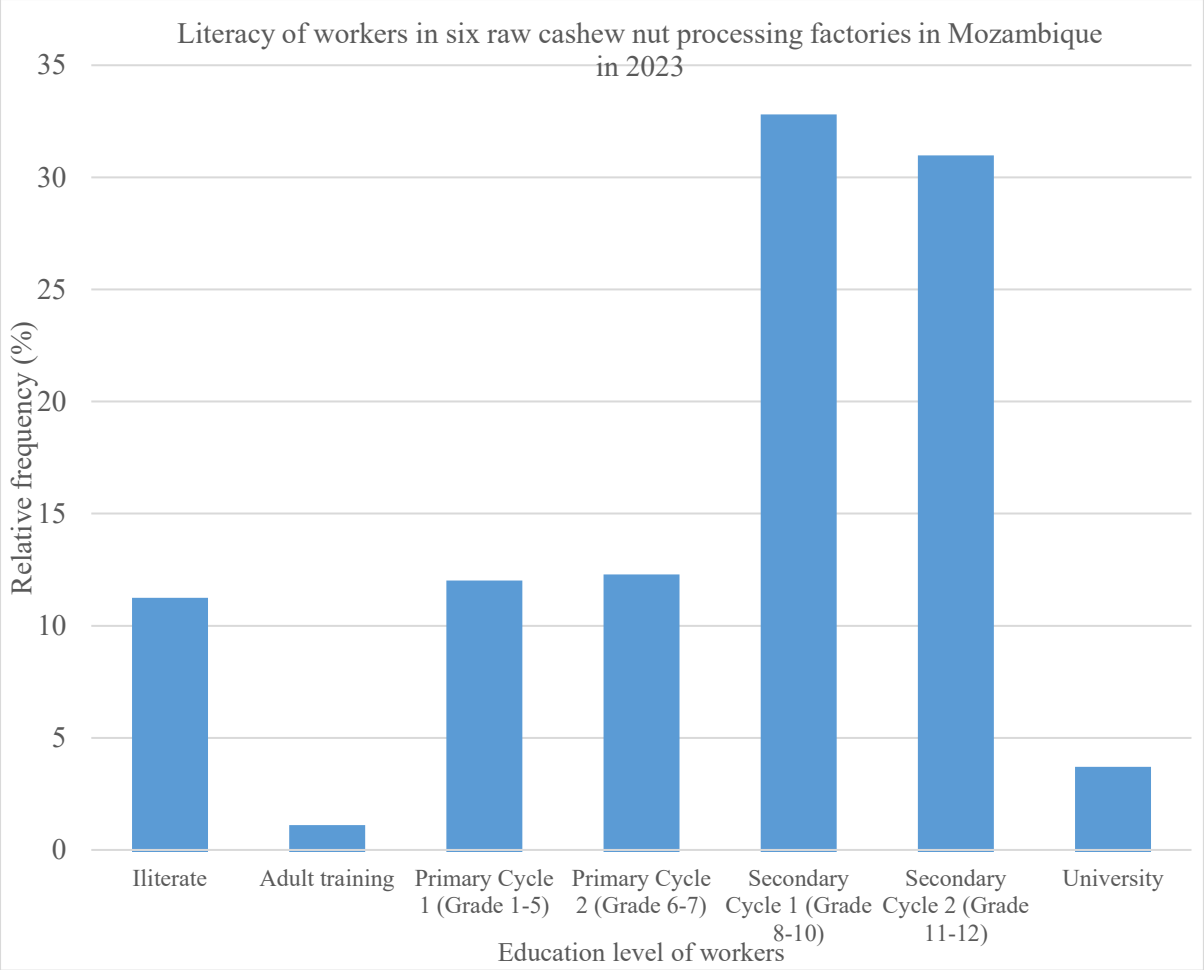

Figure 3. Literacy of workers in six raw cashew processing factories in Mozambique in 2023

Source: Authors

As per the factory layout, the kernel selection section, takes 30 percent of the workers. It employs the most people in the industry, followed by the shelling and scooping/recovery sections, with 21 and 18 percent of workers, respectively. The nut reception, shell processing, cashew liquid processing, and gardening sections had less workers. In terms of the distribution of women by section, there are more women in the selection section, with 104 women, followed by scooping and shelling, with 63 and 48 women, respectively. The cutting section, with 34 men, is the most male. This gender distribution of workers by section in the cashew industry was expected, as the cutting section has machines that require greater physical and repetitive effort than men, by nature, the physical strength to operate the cashew cutting machines. The results obtained in this study differ from those presented by [35], according to which men and women work together only in the cutting section, and the peeling and grading sections are

performed only by women. These differences in results may result from worker absenteeism, particularly when data collection takes place during the planting or harvesting season, when labor demand for agricultural activities is highest. Other causes of absenteeism in the cashew industry are cited [12] as health problems, the death of a family member, friend, or neighbour, or excessive workload. Although women are the majority, there are work sections where they are underrepresented, namely nut reception and drying, nut grading and grading, nut storage, stuffing, shell processing, cashew shell liquid processing, and gardening. Figure 4 depicts the distribution of workers in the cashew nuts processing factory by section and gender.

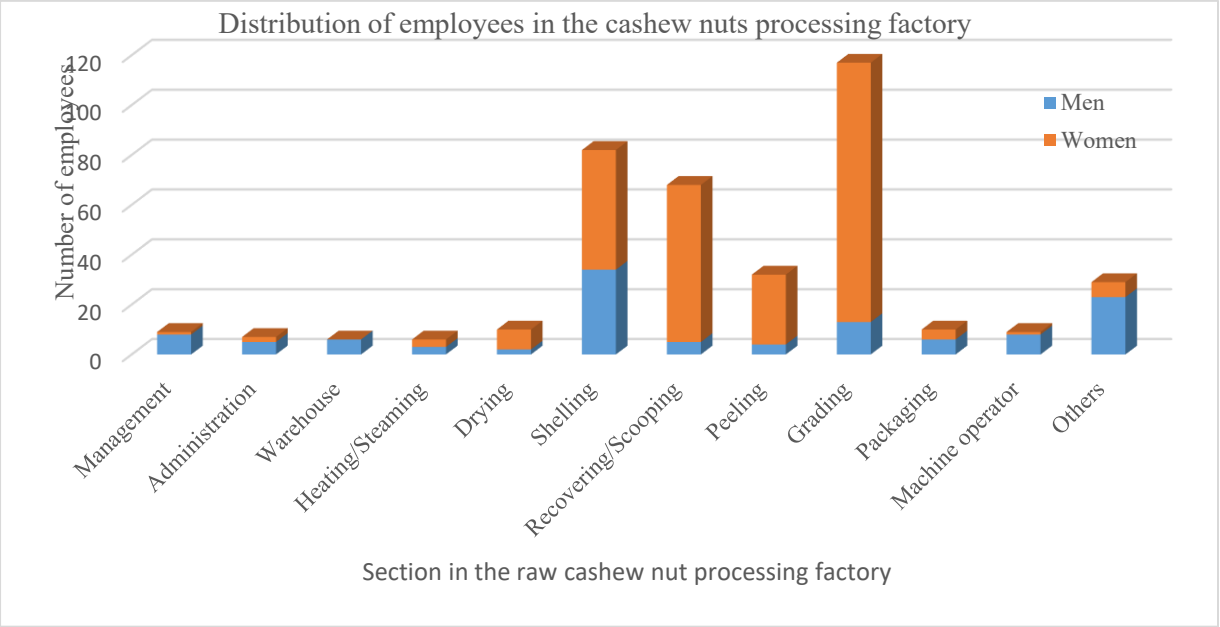

Figure 4. Distribution of workers in the cashew nuts processing factory by section and gender in Mozambique in 2023.
Source: Authors.

3.2. Analysis of Cashew Industry Sustainability Scores (CSS) and Corporate Sustainability Grid Positions (CSG)

The Cashew Industry Sustainability Score (CSS) analysis shows that none of the companies investigated performed poorly or unsatisfactorily in terms of corporate sustainability. With the exception of Company B, all achieved a Corporate Sustainability Score of 3 (Relative Corporate Sustainability), demonstrating that these companies perform satisfactorily across the three sustainability dimensions considered. Despite weaknesses in some initiatives, they generally demonstrate a significant balance in their sustainable development initiatives. Table 2 presents the Cashew Industry Sustainability Scores (CSS).

Table 2. Corporate Sustainability Score (ESE) of Mozambican cashew processing factories, in 2023.

Cashew nuts processing factory	SCORES			
	Environmental score (EPS_A)	Economic score (EPS_E)	Social score (EPS_S)	Corporate Sustainability Scores (ESE)
A	1	1	1	3
B	1	0	0	1
C	1	1	1	3
D	1	1	1	3
E	1	1	1	3
F	1	0	1	2

Source: Authors.

Company B achieved a Corporate Sustainability score of 1, indicating satisfactory performance only in the environmental dimension, and unsatisfactory performance in the economic and social dimensions, thus slightly below the minimum values required to achieve satisfactory performance. Company F achieved a Corporate Sustainability score of 2, indicating satisfactory performance in both sustainability dimensions: environmental and social. However, this company achieved unsatisfactory performance in the economic dimension, achieving results slightly below the minimum satisfactory levels. Therefore, it is suggested that it should improve its performance in relation to the indicators related to the economic sustainability dimension. Based on interactions between the possible performances of Partial Sustainability Scores (PSS) and the four corporate sustainability bands of the Corporate Sustainability Scores (CSS), eight spatial positions can be categorized that comprise the Corporate Sustainability Grid (CSG). The interactions that defined the companies' positions in this study are presented in Table 3.

Table 3. Interactions between Partial Sustainability Scores (PSS) and Corporate Sustainability Scores (CSS) among Mozambican cashew nut processing factories in 2023

Cashew nuts processing factory	SCORES				
	Environmental score (EPS_A)	Economic score (EPS_E)	Social score (EPS_S)	Corporate Sustainability Scores (CSS)	Positioning in the Corporate Sustainability Grid (CSG)
A	1	1	1	3	VIII
B	1	0	0	1	II
C	1	1	1	3	VIII
D	1	1	1	3	VIII
E	1	1	1	3	VIII
F	1	0	1	2	VII

Source: Authors.

The positioning of the six companies in the Corporate Sustainability Grid (CSG) was as follows: Companies A, C, D, and E were located in quadrant VIII; Company B was located in quadrant II; and Company F was located in quadrant VII. The spatial positions of the GSE were obtained from the different combinations proposed and presented in Table 2 and are presented in Figure 5.

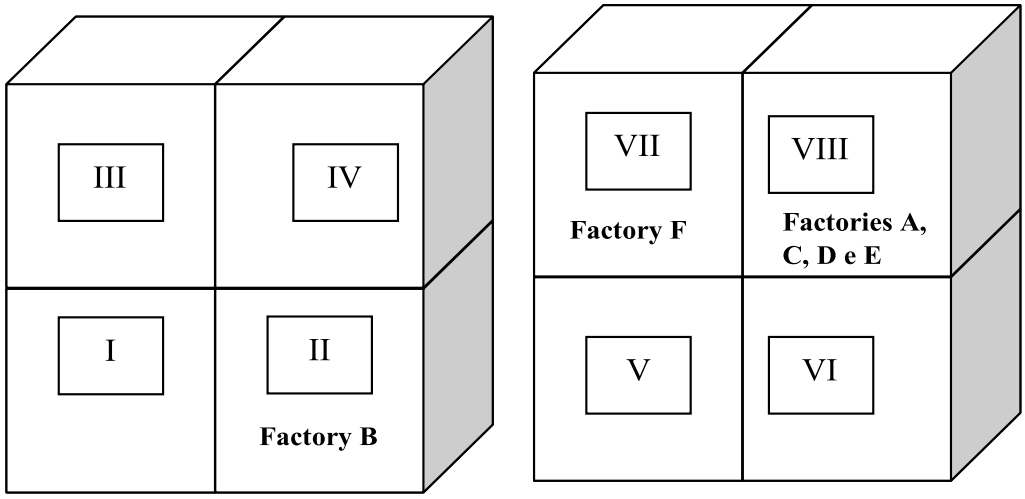

Figure 5. Spatial positions of the Corporate Sustainability Grid (CSG) of Mozambican cashew processing factories in 2023.

Source: Authors, adapted from *[26]*.

These company positions on the Corporate Sustainability Grid (CSG) highlight the heterogeneity of the Mozambican cashew industry regarding three-dimensional sustainability indicators (economic, social, and environmental). Therefore, none of them satisfactorily meets all of these indicators. Therefore, in the environmental sustainability dimension, the major challenge is related to the management of cashew shells. In the economic sustainability dimension, the main challenges are related to the industry's idle capacity due to the unpredictable availability of cashew nuts in terms of quantity and quality, combined with financing at uncompetitive interest rates and the downward trend in cashew nut prices on the global market. In the social dimension, significant efforts are being made to provide personal protective equipment and pay labor rights, but there is also the challenge of ensuring that workers have company support to continue formal training, which will ultimately contribute to improved professional performance and increased company productivity.

3.3. External factors on the sustainability practices

External factors for the cashew industry are elements external to the business environment that influence its activity and performance. The main external factors that have a significant influence on the cashew nut processing factories are grouped as follows.

3.3.1. Source of Raw Material

Producers are the primary source of cashew nuts for the industry. Most producers are located in rural areas and own an average of 30 cashew trees, planted dispersedly [3]. Production per producer is very low, and therefore, the quantity of cashew nuts sold per producer is also very low. Combined with the low supply capacity of cashews per producer, there are large distances between producing communities and the low organizational capacity of producers within each community. These factors combine to create the conditions for the emergence of primary traders, small, informal local buyers who purchase small quantities and aggregate the nuts to sell to intermediaries. Small, local traders purchase nuts in quantities that rarely exceed 5 tons and are predominantly unaware of cashew nut quality, often purchasing immature or excessively moist cashew nuts that arrive at the industry with irremediable quality problems. On the other hand, small traders lack jute or sisal bags and package their cashews in raffia bags, which are unsuitable because they accelerate spoilage. Additionally, they lack training in the dynamics of the cashew market and often charge prices that are out of sync with the market, to the detriment of the producer. These low prices discourage producers from prioritizing the production and sale of high-quality cashews. Small local traders are crucial to the marketing chain, able to reach remote areas, often with traffic issues during the marketing season, and thus serving as the link between the producer and the cashew industry.

The challenges on the raw material supply side are related to: (i) improving cashew nut productivity and quality, (ii) availability of appropriate bags for packaging the nuts, (iii) organizing producers for joint marketing, improving aggregation and negotiation capacity; and (iv) availability of appropriate cashew nut storage conditions.

3.3.2. Competition for raw cashew nut

Competition for cashew nuts is very fierce between industrialists and exporters. Although some industrialists are also exporters, [36] states that competition for cashew nuts dates back to the early 1950s. At that time, competition was with the emerging and thriving Indian industry.

Currently, competition has intensified with the emergence of the Vietnamese cashew nut market. Therefore, the survival of the domestic industry suggests its ability to adapt to the growing pressures from the Indian and Vietnamese industries, whose demand far exceeds domestic cashew nut production capacity. The Indian cashew industry has financed cashew nut buyers who enter Mozambique during the marketing period, on tourist visas. These buyers have high financial resources and presumably use illegal means to export cashew nuts, thus avoiding the surcharge. Without paying the cashew export surcharge, these buyers can offer higher prices to producers and distort the market price. Existence of informal cashew processing operators, motivated by the retention of cashews by producers due to low harvest prices. In fact, a significant portion of producers have sold cashews to small processors who offer better prices. Informal processors process small quantities that are sold locally, primarily in cities and along primary and secondary roads. Some of the processed nuts are sold in small quantities to neighboring countries, such as Malawi, Zimbabwe, South Africa, and even Zambia, through cross-border trade [10]. The challenges of the cashew industry include: (i) lack of competitive financing to purchase cashew nuts, (ii) high transportation costs to access rural areas where cashew nut production occurs, which during marketing are made worse by the precariousness of roads during the rainy season, (iv) insufficient quantities of cashew nuts to achieve economies of scale, contributing to increased operating costs and to industry idleness and worker absenteeism, (v) the existence of parachute traders who distort the cashew nut industry market, and (vi) lack of quality certificates.

3.3.3. Competition for the Cashew Kernel Market

On the supply side, Mozambique ranks fifth globally in cashew processing and kernel exports, in a ranking dominated by Vietnam, followed by India, Brazil, and Côte d'Ivoire [37]. Vietnam and India process and market 77% of global production. Vietnam supplies 75% of the world's exported kernels, which raises concerns, but produces only 11% of the nuts, purchasing over one million tons per year of raw materials from Africa to process and export to major consumer markets [34]. On the demand side, the cashew kernel market is driven by consumers whose needs are constantly evolving and are guided by concerns about quality, food safety, and traceability. Thus, India is the largest consumer of cashew nuts, followed by the United States and the European Union [38]. India and the United States consume 55% of the world's nuts. Due to increased consumption, the global cashew market experienced an exceptional period of growth in the first half of the last decade until 2017, which led to a surge in prices. According

with [38], the price of cashew nuts rose from US$3.70 per pound to US$5.10. This increase was contributed to by strong global demand, driven by growing consumer awareness of their health benefits, combined with significant investments in processing facilities, especially in Vietnam. With the emergence of the COVID-19 pandemic, prices began to fall dramatically, precipitating the closure of some cashew processing plants in the country. After COVID-19, cashew nut prices have shown an upward trend, although they are still below pre-pandemic levels. The rise in cashew nut prices could be halted due to the escalation of the war between Russia and Ukraine, which could pressure consumers to prioritize cereals. The Mozambique Challenge involves developing the domestic cashew nut market, exploring regional markets, and a marketing campaign to raise awareness among potential consumers about the health benefits of cashew nut consumption.

3.3.4. Legislation on the cashew value chain

Legislation on the cashew value chain influences the environment in which the cashew industry operates. Indeed, Mozambique approved the new Cashew Law, which establishes a 22% surcharge on the export of cashew nuts and a 15% surcharge on the export of unpeeled cashew kernels. The European Union introduced a new food supply chain regulation aimed at promoting a more transparent, ethical, and sustainable supply chain [39]. This regulation aims to improve human well-being, protect and regenerate nature, and identify human rights risks in the supply chain. The challenges posed by the new regulation on the cashew value chain include: (i) the need for transparency and traceability, compliance with labor, health, and safety standards; (ii) environmental performance and efforts to understand and reduce carbon emissions and ethics; (iii) minimum wage assessment; and (iv) carbon neutrality certification. India is in the process of reviewing the grades of cashew kernels for commercialization. Currently, there are more than 26 marketable grades or types of kernels. The grades should be grouped into six types: W200/W210, AW/W300, SW, and WW450 [40]. This aggregation of grades will facilitate sorting at the factory and improve productivity, as well as enable marketing through digital platforms and e-commerce.

4. Conclusions

The cashew industry in Mozambique is highly heterogeneous in terms of economic, social, and environmental sustainability indicators, and none of them satisfactorily meets all of these indicators. Therefore, in the environmental sustainability dimension, the major challenge is related to the management of cashew shells.

In the economic sustainability dimension, the main challenges are related to the industry's idle capacity due to the unpredictable availability of cashew nuts in terms of quantity and quality, combined with financing at uncompetitive interest rates and the downward trend in cashew nut prices on the global market.

In the social dimension, significant efforts are being made to provide personal protective equipment and pay labor rights, but there is still the challenge of ensuring that workers have company support to continue formal training, which will ultimately contribute to improved professional performance and increased company productivity.

Several environmental factors influence the cashew industry and pose vital challenges to its sustainability, including unfair competition from illegal foreign buyers for cashew nuts, which distort the market.

Mozambican primary cashew processing companies vary greatly in their performance when considering economic indicators. Some performed superiorly in four of the 14 indicators considered, while others performed poorly. Still others performed intermediately. Therefore, recommendations for improving indicators are given specifically for each processing unit, taking into account other analytical dimensions and the environment. Furthermore, the consolidated economic sustainability score showed that four of the six companies analyzed achieved satisfactory performance. The remaining two companies performed unsatisfactorily. Companies with unsatisfactory performance should improve indicators related to investment in clean technologies; environmental protection spending; sales volume; and expenditure on benefits and quality seals.

5. Recommendations

Despite the complexity of the factors associated with the sustainability of the cashew industry, to ensure its sustainability, the following are recommended:

On the environmental level, improving cashew shell management should be done through processing to obtain cashew shell liquid and using bagasse for thermal energy;

On the economic level, reducing industrial idle capacity should be done by increasing cashew nut productivity and quality and providing financing at competitive interest rates; and

On the social level, ensuring that workers have company support to continue formal training and daycare facilities should be provided so that employees' children have access to basic care, including food, while their parents work in the industry.

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