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CLIMATE CHANGE AND THE CIRCULAR ECONOMY: IMPACTS AND SUSTAINABLE ALTERNATIVES IN THE AÇAÍ PRODUCTION CHAIN

MUDANÇAS CLIMÁTICAS E A ECONOMIA CIRCULAR: IMPACTOS E AS ALTERNATIVAS SUSTENTÁVEIS NA CADEIA PRODUTIVA DO AÇAÍ

CAMBIO CLIMÁTICO Y ECONOMÍA CIRCULAR: IMPACTOS Y ALTERNATIVAS SOSTENIBLES EN LA CADENA DE PRODUCCIÓN DEL AÇAÍ

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ABSTRACT

Climate change has a direct impact on the circular economy, as changes in climate variables such as air temperature compromise the production of açaí. The gap that motivated this research is in terms of understanding the interaction between climate change, the circular economy and açaí and the effect of this on riverside communities. Therefore, the objective of this research is to understand this triad interferes in the riverside community socially and economically. The methodology used was the secondary investigative (desk research), obtaining the literature to compose the corpus of this research, in electronic links that store literature related to the theme of this research. The data obtained and analyzed indicated that climate change interferes in two ways in the production of açaí, by increasing the precipitation rate and flooding of areas where the clump is inserted. The circular economy acts to mitigate the accumulation of solid waste, especially burning and deposition in open air lessons, especially of the pits and current in a positive way in riverside communities since the use of this waste can replace income in rainy seasons. As for açaí, the analysis of the data obtained indicated that climate change causes a loss in flowering until it is lost, which determines a decrease in biodiversity diversity. Therefore, continuous studies and research, especially in the North region, must proliferate more and more, and unite riverside communities, higher education institutions and local governments in search of feasible solutions to climate change.

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Keywords: Floods. Inundations. Temperature Rise Trends. Riverside Communities.

RESUMO
As mudanças climáticas têm interferência direta na economia circular, pois as alterações de variáveis climáticas como a temperatura do ar, comprometem a produção do açaí. O gap que motivou esta pesquisa é quanto a compreensão quanto a interação entre as mudanças climáticas, a economia circular e o açaí e o efeito disto sobre as comunidades ribeirinhas. Por isso, o objetivo desta pesquisa é entender esta tríade interfere na comunidade de ribeirinhos social e economicamente. A metologia empregada foi a investigativa secundária (desk research), a obtenção das literaturas para composição do corpus desta pesquisa, em links eletrônicos que armazenam literaturas relacionadas ao tema desta pesquisa. Os dados obtidos e analisados indicaram que as mudanças climáticas interferem de duas maneiras na produçao do açaí, pela elevação da taxa da precipitação e alagamento de áreas onde a touceira está inserida. A economia circular atua de forma a mitigar o acúmulo do resídios sólidos, especialmente a queima e a deposição em lições a céu aberto, especialmente dos caroços e atual de forma positiva nas comunidades ribeirinhas já que o uso deste resíduos pode substituir a renda em épocas de chuva. Quanto ao açaí, a análise dos dados obtidos indicou que as mudanças climáticas, provoca uma perda na floração até perda dela, o que determina diminuição da diversidade da biodiversidade. Então, estudos e pesquisas contínuas,, especialmente na região Norte, devem proliferar cada vez mais, e unir as comunidades ribeirinhas, a instituições de ensino superior e os governantes locais em busca de solução exequíveis às mudanças climáticas.

Palavras-chave: Alagamentos. Inundações. Tendências de Aumento de Temperatura. Comunidades Ribeirinhas.

RESUMEN
Las cambios climáticos tienen una interferencia directa en la economía circular, ya que las alteraciones de variables climáticas, como la temperatura del aire, comprometen la producción del açaí. El vacío que motivó esta investigación se refiere a la comprensión de la interacción entre los cambios climáticos, la economía circular y el açaí, y el efecto de esta relación sobre las comunidades ribereñas. Por ello, el objetivo de esta investigación es entender cómo esta tríada interfiere social y económicamente en la comunidad de ribereños. La metodología empleada fue la investigación secundaria (desk research), obteniendo la literatura para la composición del corpus de esta investigación a partir de enlaces electrónicos que almacenan estudios relacionados con el tema. Los datos obtenidos y analizados indicaron que los cambios climáticos interfieren de dos maneras en la producción del açaí: por el aumento en la tasa de precipitación y por la inundación de las áreas donde se encuentran las matas. La economía circular actúa de manera que mitiga la acumulación de residuos sólidos, especialmente la quema y la disposición a cielo abierto, en particular de los huesos del fruto, y tiene un efecto positivo en las comunidades ribereñas, ya que el uso de estos residuos puede complementar los ingresos en épocas de lluvia. En relación con el açaí, el análisis de los datos indicó que los cambios climáticos provocan una pérdida en la floración, e incluso su ausencia, lo que genera una disminución en la diversidad de la biodiversidad. Por lo tanto, estudios e investigaciones continuas, especialmente en la región Norte, deben proliferar cada vez más y unir a las comunidades ribereñas, las instituciones de educación superior y los gobiernos locales en la búsqueda de soluciones viables frente a los cambios climáticos.

Palabras clave: Inundaciones. Crecidas. Tendencias de Aumento de Temperatura. Comunidades Ribereñas.

1 INTRODUCTION

Climate change has caused numerous impacts on crops, and global warming intensifies these effects by increasing the frequency and severity of droughts and floods, which negatively affects the development of agricultural crops, including açaí trees (Dias 2014; Mendes, 2024). These climatic variations interfere with the growth, flowering, and fruiting of açaí (Jesus, 2021; Santos; Porro, 2024), tree belonging to the species Euterpe oleracea Mart., Family Arecaceae (Nascimento, 2008). All these factors act negatively on the production of açaí.

The problem can be aggravated by the incorrect disposal of açaí biomass residues as an environmental risk factor from the progressive growth of the E. oleracea agroindustry, in the state of Amazonas, a fact that has a strong influence on the worsening of the greenhouse effect and intensification of climate change (Miranda et al., 2022). This harms the economy of riverside communities (Campos; Cardoso, 2025), because, although it is a heliotrophic plant, when there is a tendency to increase the temperature excessively, the açaí tree is impaired in terms of the development of the palm, the fruit and the tree itself (Cameli; Silva, 2023; Homma, 2006).

On the circular economy, whose Bill No. 1,874, in addition to the indirect regulation in article 7, item XI, Law No. 12,305 (Brasil, 2022; 2010). In the view of Leda, Mota and Cereto (2025), this economy builds a promising approach by promoting the regeneration of materials and the efficient use of inputs, and an incentive to reflect on the way products are created and consumed. This concern focuses on extending the useful life of raw material and strengthening the conservation of the Amazon.

In this context, in the 2000s, Cunha (2024) and Lemos (2024), stated that it represents a significant increase in demand for the açaí fruit. In the view of Almeida et al. (2017), this occurred because the residual regeneration of açaí, from the seed, is exploited by this new economy that, among so many products that it can generate, such as handicrafts. In this aspect, Pimentel (2025) reports that the handlers of this Ver-o-Peso street market already allocate this waste for handicrafts and fertilizer.

In addition, this research reports that research for the production of biofuels and bio asphalt has been advancing at UFPA since 2016. The açaí tree is identified by Miranda et al. (2022), as a palm tree typical of the floodplain region of Central and South America. Santos and Porro (2024) state that the juice is widely used to feed the population of these locations, as an important source of income, from this palm tree. In this context, Pinheiro (2023) mentions that this production chain includes extractives, farmers, intermediaries, processing industries, and artisanal scouts, playing a key role in generating income for many small producers.

In the research carried out by the Amazon Environmental Research Institute (IPAM, 2018) and da Silva (2019), they evidenced other uses for the açaí pit: in civil construction, oil production, handicrafts for internal decorations, cosmetics, among others Medicine is also helped with the pit, as Lemos (2024) described that the generation of "açaí coffee" is an alternative for the control of diabetes mellitus, from the roasted and ground seed.

Regarding climate change, Cameli and Silva (2023) report that it affects economic activities based on açaí, which becomes worrying, especially for communities dependent on the family extractive production chain, which is currently considered one of the most sustainable in Brazil. Another problem, in the view of Bentes et al. (2024), involves the need for local communities, researchers, and public managers to actively participate in joint solutions that balance productivity and sustainability in the face of climate change.

All these arguments justified this research, and increased its relevance, because the understanding of what is already published in the relationship between climate change, circular economy and açaí, should be disseminated to the population both consumers and handlers of this fruit, especially with regard to this type of economy, and that it will contribute to sustainability. Therefore, the objective of this research is: to understand and interpret how much climate change interferes in the circular economy, harms the communities that manipulate açaí.

2 METHODOLOGY

For the study in question, the secondary investigative method (desk research) was used, that is, information already contained in publications on a topic that, in this research, involved: climate change, circular economy and açaí. For Neves and Conerejo (2012), the document is an object to be investigated. The use of this method is justified because these authors report that the role of the scientific article is always to narrate a story, and this will be the basis to support the theoretical part of this study.

Due to the expansion of the subjects involved here, and the association between them, there was no concern about the type of literature, as National School of Public Administration (ENAP.GPV, 2021) argued that, regardless of the classification of literature, this method is effective for this type of research. This is in line with what is described by Macedo (2022).

This author stated that access to different academic sources such as hemerographic sources, as well as books, e-books, scientific articles, newspapers, forums, technical reports, among others, broadens the final discussion.

2.1 OBTAINING THE DATA

Secondary data were obtained from electronic links whose databases are related to research and publications aligned with the theme of this research, such as the Coordination for the Improvement of Higher Education Personnel – CAPES, institutional repositories such as the State University of Pará – UEPA, Federal University of Pará – UFPA; University of the Amazon – UNAMA, among others. The selection of literature followed the criterion of identifying keywords in three sections: title, abstract, and keywords (Table 1).

Table 1

Model for data entry regarding literature selection

			Title	Summary	Keywords	x̄	±	σ
		Açaí						
Açaí.	**Components**	Pit						
		Fruits						
		Pulp						
		Waste						
		Wine						
	Nomenclatures	*E. oleracea*						
		E. precatoria						
	Variables	Açaizal						
		Açaí-da-mata						
		Açaizeiro						
		Design circular						
		Circular economy						
		Environmental impacts						
		Climate change						

Source: authors (2025).

2.2 DEFINITION OF THE SAMPLE

The sample was defined based on the establishment of three inclusive criteria. This action was based on the report by Andreza et al. (2024) who identified: 1) free and open access; 2) Portuguese and English language; 3) involve the central theme of this research. The time frame was between 2016 and 2025, the last 10 years, with the insertion of four previous surveys: Fleck and Bourdel (1998); Homma et al., (2006); IBGE, (1993) and

Nascimento (2008), with emphasis on the last five years: 2021- 2025. An inclusion criterion was developed for the selection of literature (Table 2).

Table 2

Arguments for inclusion and exclusion of the literatures used in the composition of this research

Inclusion		Exclusion
Publication in English and Portuguese		Other Languages
Be Available in full		Partial availability of the publication
Published in the last decade (2016-2025)		Published before the temporal cut.
Have free access, that is, without charge.		Need for remuneration for access
Present, in the title or Abstract or Keywords: açai, stone, fruits, fruits, pulp, waste, wine, *Euterpe oleracea, E. precatoria,* açaí-da-mata, açaí-da-mata, açaí tree.		There are none of the selective descriptors in the three defined sections.

Source: authors (2025).

2.3 STATISTICAL ANALYSIS OF THE DATA

The data obtained after selecting the literature regarding the relationship between climate change, circular economy and açaí, the Excel 5.0 software was used, with Descriptive Statistics, and then tabulated according to the guidelines stipulated by the Brazilian Institute of Statistical Geography – IBGE (1993). Nonparametric analysis was applied due to the non-normality of the data contained.

Principal Component Analysis – PCA, was applied to reduce the size of the data used (Bertarelli Júnior, 2016), especially the descriptors. Finally, the box plot was applied, since the data were non-parametric, and the literature was grouped according to the component sections of this research. For the APC, the Kaiser method was applied. In this method, Fleck and Bourdel (1998) state that it is used to determine eigenvalues higher than one, that is, statistically significant. For the APC, the Kaiser method Applied.

3 RESULTS

3.1 SELECTIVE DESCRIPTORS

In the application of the selective descriptors, six variations "açaí" were used. The data obtained and analyzed indicated that this vernacular term was the most prolific (120 ± 128). Four of them were used less frequently: fruits, pulp, residues and wine (0.3 ± 0.6). As for scientific nomenclature, E. oleracea was more described (12.3 ± 8.7). In the ABSTRACT section, the values (15.9 ± 26.2) of occurrence of the selective describers were higher (Table 3).

Table 3

The selective descriptors isolated and associated with the Boolean descriptors were used to select the literature

	Descriptors Selective	Title	Summary	Keywords	x̄	±	σ
1	**Açaí**	**28**	**107**	**20**	**51.7**	**±**	**48.1**
2	Pit	4	12	4	6.7	±	4.6
3	Fruits	1	35	2	12.7	±	19.3
4	Pulp	1	7	0	2.7	±	3.8
5	Waste	5	28	6	13.0	±	13.0
6	Wine	0	0	0	0.0	±	0.0
7	*E. oleracea*	7	13	7	9.0	±	3.5
8	*E. precatória*	1	0	0	0.3	±	0.6
9	Açaizal	0	4	0	1.3	±	2.3
10	Açaí-da-mata	1	1	1	1.0	±	0.0
11	Açaizeiro	0	9	0	3.0	±	5.2
12	Designer circular	1	1	1	1.0	±	0.0
13	**Circular economy**	**0**	**6**	**1**	**2.3**	**±**	**3.2**
14	Environmental impact	0	5	0	1.7	±	2.9
15	**Climate changes**	**4**	**11**	**4**	**6.3**	**±**	**4.0**
	$\bar{x}$ ± σ	3.5 ± 6.9	**15.9 ± 26.2**	3.1 ± 5.1			

Source: authors (2025)

It can be seen in table 1 that studies on climate change in the Amazon and the effects on açaí are still scarce (5.7 ± 3.8). The most critical is related to the environmental impacts due to improper disposal of residual components such as the stone after mechanical agitation to obtain the groove (0.3 ± 06). However, research on the circular economy with the reuse of this "Amazonian food" has advanced (7.7 ± 5.0). The eigenvalues validated and analyzed by the Kaiser criterion (> 1), for the 15 selective descriptors used, indicated that the selective descriptor "açaí" (98.8%), represents that, for the choice and selection of literatures, represent the others very well, and was more efficient among all the others used (Table 4).

Table 4

Eigenvalues and values for variance found

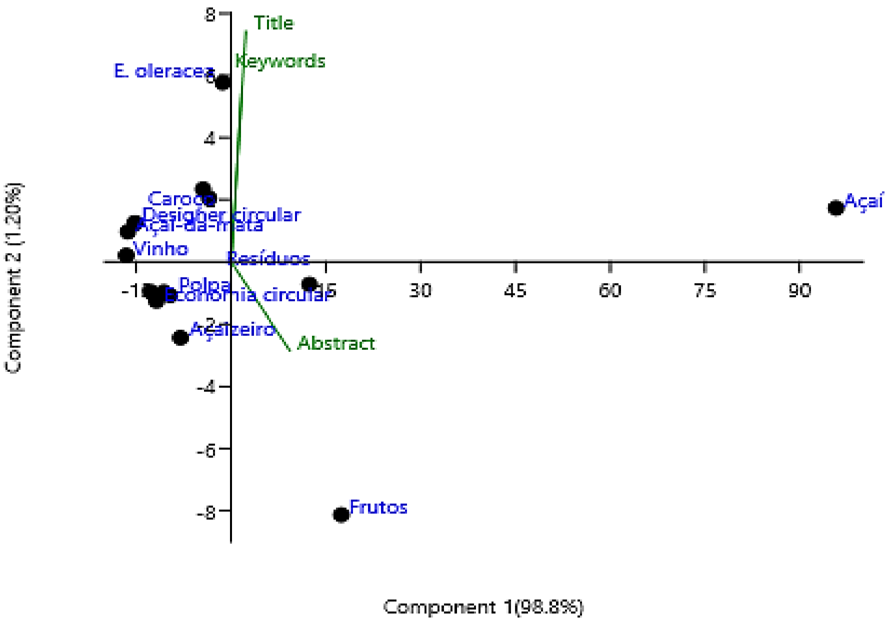
PC	Eigenvalue	% variance
1	**803.466**	**98.813**
2	**9.09705**	**1.1188**
3	0.551318	0.067803

Source: authors (2025)

In the Principal Component Analysis (PCA) it was confirmed that this quantitative (15) was used in the selection of the literature to compose the corpus of this research, both in the title, in the abstract and in the keywords (Figure 1).

Figure 1

Analysis of the main components regarding the selective descriptors applied

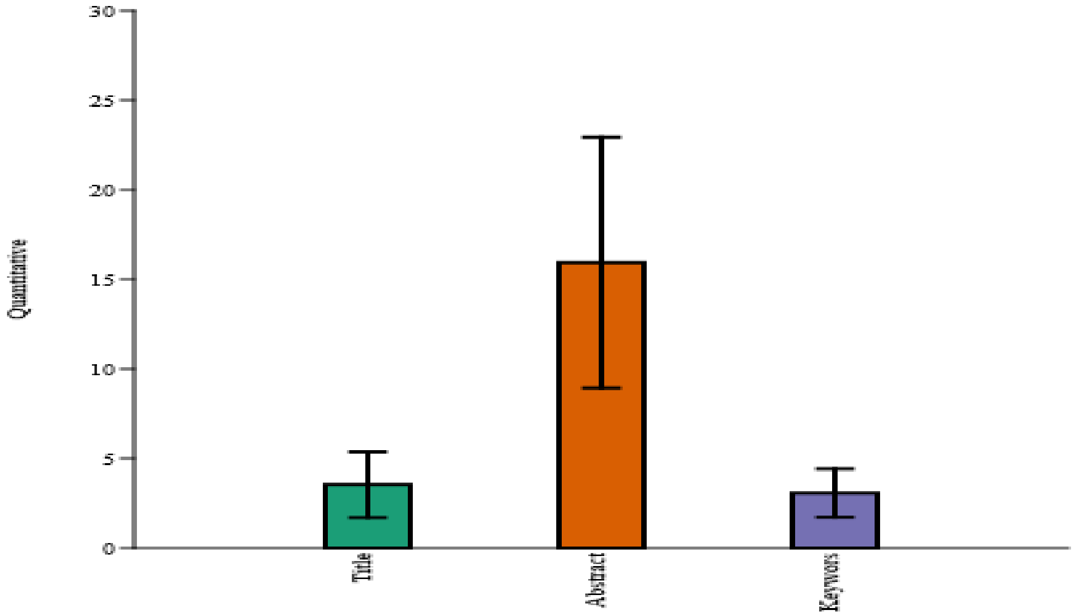


Source: authors (2025)

In the reading of the scores generated, it was verified in Figure 1 that two selective variables "fruits (≈ 17%) and residues (≈ 12%)" correlate directly and positively with the variable "açaí" (≈ 95.7%). This shows that the choice of this descriptive selector was effective in the selection of literatures for the composition of the corpus of this research. In the verification of the distribution of the data used for the selection of the literature, the central tendency of the three sections analyzed in the selected literatures, the maximum limit reached was in the abstract, followed by the title and ending with the keywords (Figure 2).

Figure 2

Central trend and quartiles of distribution of the application of selective descriptors in the three sections of the selected literature

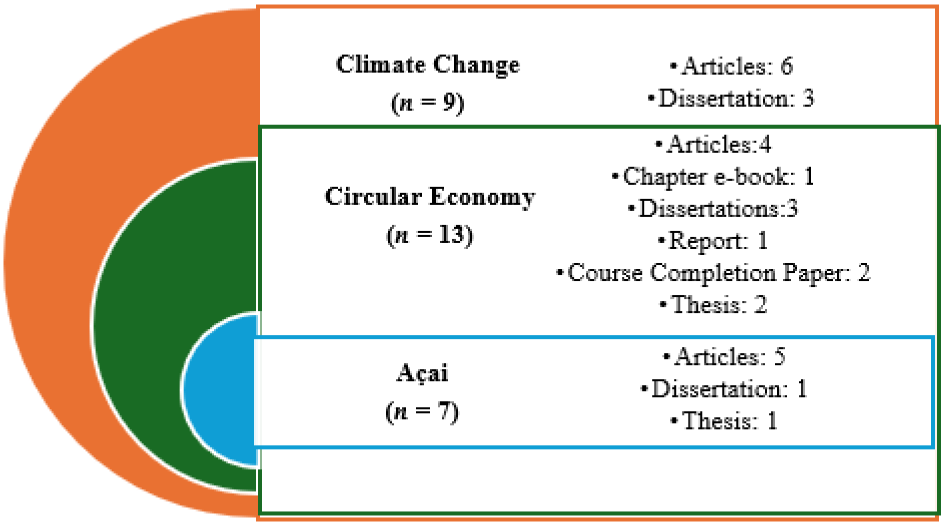


Source: authors (2025)

After selecting the literatures (∑ = 29), they were inserted in the component sections of this research according to the pre-established order for the composition of the bodies of this research (Figure 3).

Figure 3

Distribution of literature was published between 2016 and 2025, according to the three sections that make up the corpus of this research



4 DISCUSSION

4.1 CLIMATE CHANGE

Regarding the social and environmental aspects of the Amazon region, Campos and Cardoso (2025) state that climate change is a key factor in the negative impact on açaí production, the balance of ecosystems and, mainly, on the economy of riverside communities (Homma et al., 2006; Cordeiro et al, 2024). On the other hand, Miranda et al. (2022) indicated the incorrect disposal of E. oleracea biomass residues as an environmental risk factor from the progressive growth of the açaí agroindustry in the state of Amazonas. In the eastern Amazon, Moraes et al. (2023), have already identified serious climate changes that are causing trends of increase in air temperature, harming the production of açaí.

From this perspective, Moraes (2025) explains that methane gas (〖CH〗_4) is one of the main greenhouse gases, and that during the irregular disposal of the açaí seed, an organic material that has an anaerobic decomposition, the fermentation of this waste and the release of this gas occurs, thus contributing to climate change. In addition, Strapasson and Ribeiro (2025) describe that the intensive cultivation of açaí and the expansion of its areas is one of the main causes of the reduction of plant diversity, where the implementation of monoculture on native vegetation affects not only biodiversity, but also ecological resistance against the intensified greenhouse effect.

The high intensity of this effect may generate food insecurity for the riverside population, mainly. In this regard, Vieira (2024) reveals that in addition, there will be a compromise in the economy of local communities in the Amazon that are directly affected by droughts and heat waves arising from climate change. Igawa, Fonseca and Bendini (2025), wrote that perennial crops act as an alternative to control this climate problem, and açaí is extremely important for carrying out these mitigation actions, as it is the main perennial crop in the Amazon biome.

4.2 CIRCULAR ECONOMY

For the circular economy, there are several uses for the açaí seed after pulp extraction. Among them, the generation of biofertilizers. In this context, Oliveira Neto et al. (2025), report that the post-extraction seed tends to act directly on three soil conditions: 1) it increases water retention; 2) increases soil fertilization; reduces losses from surface runoff and volatilization. Pinto (2022) presents as a circular economic factor, the formation of biopolymeric packaging, since in these stones and fibers, there are bioactive compounds such as anthocyanins, polyphenols and flavonoids.

From another point of view, Leda, Mota and Cereto (2025) present the circular economy as a promising approach by promoting the regeneration of materials and the efficient use of inputs, and this encourages reflection on the way products are created and consumed. This concern focuses on extending the useful life of raw material and strengthening the conservation of the Amazon. In this context, Cunha (2024) reports that the 2000s represented a significant increase in demand for the açaí fruit, and the excellent news is provided by Lemos (2024), when he wrote that riverside communities in the northern region of Brazil use roasted and ground stone powder at fairs and artisanal stores as antioxidant products beneficial to health.

Such conservation is better explained in the report by Baia et al. (2025). He confirms that o Açaí represents 95% of the national production. As a result, there was an expansion of the industrial sectors and extractive rural workers. Regarding these data, Cordeiro et al (2024) highlight that, when comparing the economic data of a city in government sources and the primary dynamics of the municipality, the production of açaí assumes a great influence on income generation and growth rate influencing the increase in livelihoods and family farming, reflecting in the significant improvement of the quality of life of the local community.

In view of this, Cameli (2023) elucidates that the açaí fruit started to be consumed by other states in Brazil in addition to the northern region, gaining the national and international market, becoming a versatile tool for the productive sectors since all parts of its palm tree can be used. Herminio (2023) warns that despite the economic advantage, the processing of the crop generates a large amount of waste that is often disposed of inappropriately, which induces the potential for the development of value-added products.

In the context of this economy, the seed is already inserted for the production of cement, in the municipality of Primavera, state of Pará, at the Votorantim Cimentos plant. Another insertion in the circular economy is reported by Pinto (2022), who studied the bioactive compounds inserted in the seed, which can generate new packaging with biopolymeric characteristics. Miranda et al. (2022), add that they can be used to generate new seedlings, in addition to coal (generated at 1050 º C), and other fuels such as ethanol, without forgetting fertilizers, bran and fertilizer.

4.3 AÇAI

Climate change represents one of the greatest environmental challenges of our time. Cameli and Silva (2023), indicated that this directly affects ecosystems and food production across the globe. This also occurs in the Amazon region, with one of the most consumed products by the local community: açaí. This fruit plays a fundamental role in the food, economy and culture of the Amazonian populations. Studies carried out by the Institute for Environmental Research (IPAM, 2018) and Pinto (2021), identified that the advance of climate change threatens the sustainability of this production chain.

Such climate changes interfere with the generation of fruits, and this is already noticeable to the riverside producers of açaí, Almeida et al.(2017) and Tregidgo et al. (2020) report that this statement is already present in the statement reported in riverside dwellers in the Amazon, where most of them (77%) verified a decrease of around 45% in relation to fruits in times of high temperatures. Dias (2014) found that low productivity occurs in the rainy season, and the opposite in the dry season. This harms the riverside community, both in terms of food and the economy.

This is corroborated by Jesus (2021), when he wrote that the trend of increases in temperatures, the change in the rainfall regime, and the more frequent occurrence of extreme events, such as prolonged droughts and intense floods, interfere with the growth, flowering, and fruiting of açaí. Moraes et al. (2023), stated that, although açaí is dependent on a high volume of water, especially those events arising from climate change. The contrast to this statement is provided by Silva (2019), has already found that in the northeast of the state of Pará, there is already a reduction in the precipitation rate.

5 CONCLUSION

Climate change, especially the trend of rising air temperature, causes a decline in the percentage of air humidity. However, in some locations there are variations in precipitation rates, which increases the volume of water in seas and oceans in the Amazon. This fact causes a drop in the production of açaí, which may generate a decrease in the food supply of riverside dwellers, as well as interfere with their financial income, and this has already been carried out from the point of view of riverside communities in the states of Amazonas and Pará.

As for the circular economy, in view of these decreases, it may compromise studies and research on products derived from açaí seeds, with regard to coffee powder, composting to improve soil fertility, especially in areas that may be subject to soil recovery. The generation of biofuels and medicinal products for the control of Diabetes Mellitos. So, in addition to the food commitment, the secondary products that could add income to the riverside dwellers. Even the research now being carried out by the universities of Pará would suffer a drop.

With regard to açaí, as a profitable fruit and feed not only the riverside community but thousands of consumers nationally and internationally. To avoid this, there is already a proposition that tackling climate change with an expansion of science and technology. Another perspective is the loss of blooms and, consequently, biodiversity, and solutions must be integrated between researchers, riverside communities, governors and other authorities involved in the dimension of loss of this plant.

All these confrontations must be carried out urgently, since climate change has already reached high levels of extreme events for riverside communities that feed and generate income from the production of açaí. We suggest that research be intensified in two sectors: circular economy and mitigating the effects of climate change.

REFERENCES

Almeida, O. T., Rivero, S., Alvez-Valles, C. M., & Dou, Y. (2017). Percepção do impacto de eventos extremos sobre a produção pela população do estuário Amazônico. Revista Iberoamericana de Economía Ecológica, (27), 59–70.

Andreza, M. N. S., et al. (2024). Benefícios de uma gestão ambiental sustentável. Brazilian Journal of Development, 10(7), Article e71394.

Baia, C. M., et al. (2024). Análise do gerenciamento do resíduo do açaí a luz dos planos municipais paraense. In Anais do 33º Simpósio de Estudos e Pesquisas em Ciências Ambientais na Amazônia.

Bentes, M. P. M., et al. (2025). Mudanças climáticas e a produção de açaí nativo no estuário amazônico – estudo de caso na comunidade de Jupatituba, Breves-PA. In Anais do 13º Simpósio de Estudos e Pesquisas em Ciências Ambientais na Amazônia (pp. 1–2). Doity.

Betarelli Júnior, A. A. (2016). Análise multivariada I. Conteúdo 2 – N_Análise de Componentes Principais ACP. Universidade Federal de Juiz de Fora.

Brasil. (2001). Política Nacional de Economia Circular. Senado Federal.

Brasil. (2010). Política Nacional de Resíduos Sólidos, de 2 de agosto de 2010. Presidência da República. http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm

Cameli, M. R. F. (2023). Planejamento regional e geoeconomia: A rede produtiva do açaí na Amazônia Sul-Ocidental [Dissertação de mestrado, Universidade Federal do Acre].

Cameli, R., & Silva, C. H. R. (2023). Bioeconomia e performance geoeconômica no cenário de mudanças climáticas: O caso de Bailique/AP - Brasil. Revista Científica Multidisciplinar, 4(10), 1–15.

Campos, G. P. F. P., & Cardoso, M. B. C. (2025). Vulnerabilidade da produção de açaí frente às mudanças climáticas. Revista Eletrônica Amplamente, 4(3), 753–769.

Cunha, A. B. C. (2024). A produção e a comercialização do açaí-da-mata no município de Anori-AM [Dissertação de mestrado, Universidade Federal do Amazonas].

Dias, T. S. da S. (2014). Sazonalidade climática regional e a produção dos frutos de açaí (Euterpe oleracea Mart.) no nordeste paraense [Dissertação de mestrado, Universidade Federal do Pará/EMBRAPA].

ENAP.gov. (2021). Como fazer uma desk research eficaz, enriquecendo sua pesquisa. https://desafios.enap.gov.br/index.php/pt/blog/mapeandoproblemas/como-fazer-desk-research

Fleck, M. P. A., & Bourdel, M. C. (1998). Método de simulação e escolha de fatores na análise dos principais componentes. Revista de Saúde Pública, 32(3), 267–272.

Hermino, V. L. de Q. (2023). Avaliação da fermentação de hidrolisados de sementes do açaí para a produção de bioetanol e ácidos orgânicos no contexto de biorrefinaria de segunda geração (2G) [Dissertação de mestrado, Universidade Federal do Amazonas].

Homma, A. K. O., et al. (2006). Açaí: Novos desafios e tendências. Amazônia: Ciência & Desenvolvimento, 2(1), 7–23.

IBGE. (1993). Normas de apresentação tabular (3ª ed.).

Igawa, T. K., Fonseca, L. M. G., & Bendini, H. do N. (2025). Efeito da mudança de uso e cobertura da terra na produtividade de açaí no estado do Pará. In Anais do 21º Simpósio Brasileiro de Sensoriamento Remoto (pp. 247–250). Galoa. https://proceedings.science/sbsr-2025/trabalhos/efeito-da-mudanca-de-uso-e-cobertura-da-terra-na-produtividade-de-acai-no-estado?lang=pt-br

IPAM. (2018). Desafios para a sustentabilidade na cadeia do açaí.

Jesus, T. F. de. (2021). Manejo, produção e qualidade de açaí de terra firme associado à densidade de touceira e adubação orgânica sob sistema agroflorestal [Dissertação de mestrado, Universidade Estadual do Maranhão].

Leda, G. O., Mota, S. C., & Careto, M. P. (2025). Design circular na Amazônia e a valorização de produtos naturais regionais. Arcos Design, 18(2), 337–356.

Lemos, F. M. F. do C. (2024). Café de açaí: Um estudo etnofarmacológico em terapêutica [Tese de doutorado, Universidade Federal do Tocantins].

Macedo, C. (2022). Guia rápido de desk research. UX Collective BR. https://uxdesign.cc/guia-r%C3%A1pido-de-desk-research-8f8c8e8f8e8f

Mendes, E. do N. (2024). Produção de filmes poliméricos biodegradáveis a partir do óleo da polpa de açaí (Euterpe oleracea Mart) com atividade antifúngica para possíveis aplicação na indústria de alimentos [Tese de doutorado, Universidade Federal do Maranhão].

Miranda, D. P. A., et al. (2022a). A importância de uma política de resíduos na agroindústria do açaí do Amazonas (Euterpe precatória Mart.). Research, Society and Development, 11(13).

Miranda, L. V. A., et al. (2022b). Descarte e destino de caroços de açaí na Amazônia Oriental - Brasil. Ambiente & Sociedade, 25.

Moraes, B. C., et al. (2023). Risco agrometeorológico: Impacto da variabilidade dos episódios de seca sobre a produção de açaí (Euterpe oleracea Mart.) na Amazônia Oriental. Revista Brasileira de Geografia Física, 16(4), 1685–1696.

Moraes, L. C. M. (2025). Gestão de resíduos sólidos do caroço de açaí e construção de uma ferramenta de educação ambiental [Trabalho de conclusão de curso, Universidade Federal Rural da Amazônia].

Nascimento, W. M. O. do. (2008). Açaí Euterpe oleracea Mart. Informe Técnico Rede de Sementas da Amazônia, (18).

Neves, M. F., & Conejero, M. A. (2012). Uma contribuição empírica para geração de métodos de planejamento e gestão. Revista de Administração, 47(4), 600–714.

Oliveira Neto, A. A. de, Costa, L. M., & Correa, L. dos A. (2025). Perspectivas do reaproveitamento do caroço do açaí em Santana-AP [Trabalho de conclusão de curso, Universidade Federal do Amapá].

Pimentel, D. (2025, 13 de fevereiro). COP 30: Descarte de caroços de açaí vira desafio na busca por soluções sustentáveis em Belém. O Liberal. https://www.oliberal.com/cop-30/cop-30-descarte-de-caroços-de-açaí-vira-desafio-na-busca-por-soluções-sustentáveis-em-belém

Pinto, L. M. dos R. B. (2021). A importância da bioprospecção para desenvolvimento sustentável na Amazônia legal: O açaí com base em Saccaro Júnior [Dissertação de mestrado, Universidade Federal do Amazonas].

Pinto, M. P. de A. (2022). Análise da viabilidade tecnológica da obtenção de biopolímeros a partir da ação para aplicação em embalagens [Trabalho de conclusão de curso, Universidade Federal do Rio de Janeiro].

Santos, A. C. S., & Porro, R. (2024). Empobrecimento florístico da Amazônia: Impactos da demanda do açaí para a biodiversidade brasileira. Nova Revista Amazônica, 12(3).

Silva, A. M. V. da. (2019). Avaliação do comportamento térmico de compósitos poliméricos produzidos com resíduos de açaí em edificações na Amazônia [Dissertação de mestrado, Universidade Federal do Amazonas].

Strapasson, S. M. S., & Ribeiro, D. H. B. (2025). Potencial de aplicação de resíduos do cacau (Theobroma cacao) e açaí (Euterpe oleracea). Científica Digital Online, 1(2), 22–39.

Tregidgo, D., et al. (2020). Vulnerability of the açaí palm to climate change. Human Ecology, 48, 505–514.

Vieira, J. W. da S. (2024). Açaí em perigo: Crise climática um ameaça um símbolo da Amazônia [Produto educacional, Universidade do Estado da Bahia].