



AGRICULTURAL PRODUCTION: ECONOMIC PERFORMANCE OF SISAL (*Agave sisalana Perrine*) IN THE INTERANNUAL PERIOD FROM 2009 TO 2022 IN THE STATE OF PARAÍBA

Djair Alves da Mata^{1*}, Daniel Alves da Mata², Geiziane de Fátima da Silva¹, Vanessa Silva Souza², Josefa Dayse Lima Silva²

ABSTRACT: Sisal (*Agave sisalana Perrine*) is a highly diversified plant throughout the world, with Brazil being one of the largest producers and exporters in the international context. In addition, sisal cultivation represents a strong socio-economic aspect, whether generating income or jobs. The aim of this study is to highlight the economic importance of sisal and its social impact on small farmers in the state of Paraíba. In order to do this, we consulted the database of the Brazilian Institute of Geography and Statistics (IBGE) for the inter-annual reference period from 2009 to 2022, as well as a thorough bibliographical review of manuscripts. For the state of Paraíba in 2022, it was possible to estimate a production of 8.835 tons of sisal fiber, for a harvested area of 10.221 ha², with an average yield of 864 kg/ha². It can be concluded that sisal cultivation has a strong impact on the state of Paraíba, one of the largest national producers. It is also clear that industrialization has led to better use of the raw material sisal, diversifying a wide variety of products. Constant research has revealed solutions and alternatives for better use of the agricultural sector for the benefit of rural people.

Keywords: agriculture, productivity, review.

PRODUÇÃO AGRÍCOLA: DESEMPENHO ECONÔMICO DO SISAL (*Agave sisalana Perrine*) NO PERÍODO INTERANUAL DE 2009 A 2022 NO ESTADO DA PARAÍBA

RESUMO: O sisal (*Agave sisalana Perrine*) é uma planta muito diversificada pelo mundo, sendo o Brasil um dos maiores produtores e exportadores no contexto internacional. Além disso, o cultivo do sisal representa um forte aspecto socioeconômico, seja gerando renda ou empregos. Esse trabalho tem por objetivo destacar a importância econômica e os seus reflexos sociais perante o pequeno agricultor no estado da Paraíba. Para tanto, foi realizada uma consulta no banco de dados do Instituto Brasileiro de Geografia e Estatística – IBGE para a referência interanual de 2009 a 2022, assim como uma minuciosa revisão bibliográfica de manuscritos. Foi possível constatar para o estado da Paraíba no ano de 2022 uma produção de 8.835 t de fibras de sisal, para uma área colhida de 10.221 ha², com um rendimento médio de 864 kg/ha². Conclui-se que o cultivo de sisal tem fortes impactos no estado da Paraíba, um dos maiores produtores nacionais, também é evidente que a industrialização ocasionou um melhor aproveitamento da matéria prima do sisal, diversificando uma grande variedade de produtos. As constantes pesquisas vêm revelando soluções e alternativas para um melhor aproveitamento do setor agrícola em benefício do homem do campo.

Palavras-chave: agricultura, produtividade, revisão.

INTRODUCTION

Sisal (*Agave sisalana Perrine*) is a species native to Central America, specifically the Yucatán Peninsula in Mexico (Trejo-Torres et al., 2018). In addition, it is widely spread throughout the world, and in Brazil cultivation takes place mainly in the semiarid regions of the northeast of the country (SILVA, 2017).

This plant belongs to the Asparagaceae family, a monocot with rigid leaves with adaptations for thorns, a poorly developed stem and hermaphrodite leaves. Its pollinating agents are hummingbirds, bees, wasps and some other species (QUEIROGA et al. 2021). The researchers also point out that the Crassulacean Acid Metabolism (CAM) allows for a reduction in

water loss, as its stomata close during the hottest hours of the day.

Given the conditions that the semi-arid region imposes on agricultural crops and agribusiness, the most striking of which is the long periods of drought, the sisal cultivar has adapted very well, making it possible not only to survive, but also to develop and provide an economic return (EMBRAPA, 2010). The agency also adds that this tropical species makes great use of its structures, with the leaves being used to extract fibers.

According to Neves (2015), Brazil stands out in the production and export of sisal, ranking first. According to Oliveira (2018), despite sisal's resistance to low rainfall, the species grows well with rainfall of

between 600 and 1.500mm/year, as well as an average altitude (above sea level) of between 200 and 800 meters, and a temperature oscillating between 20 and 28°C. The author also points out that the quality of the soil needs to be taken into account, since it is the soil that will provide the plants with nutrients. Cultivation is recommended in medium fertility soils of the siliceous and siliceous-clay type. According to Mateus (2017), the sisal cultivation cycle can vary from 8 to 10 years, depending on the practices and management used over the years, such as fertilization, pest control and cultural treatments. In addition, it is possible to harvest 50 to 60 leaves per plant, and the first cut of the sisal leaves should occur approximately 36 months after cultivation.

The authors Silva (1999) and Prossiga (2004) add that prolonged droughts of less than 400 mm/year have a negative impact on the development of the species, slowing down growth, quality and fiber yield and even causing the plant to die if the lack of water persists. The authors also point out that a pH range between 5.0 and 8.0 provides the best responses for the crop.

Sisal is highly profitable. According to Santos and Silva (2017), the fibers are used in the textile industry and the by-products are stern, mucilage, bush, juice and other derivatives. However, the authors point out that only 4% of the harvested leaves are used for shredding, generating a large amount of waste. The authors Felipe and Dias (2017) point out that industrial waste plays an important role in the production of surfactants, which are surface-active substances capable of reducing the surface tension of water and are widely used in the pharmaceutical, food, textile and cosmetics industries, among other areas.

In this context, the Brazilian semi-arid region has a high degree of variability in its natural conditions, such as topography, climate, relief and soil. The long periods of drought with low rainfall rates, as well as considerable evapotranspiration, contribute significantly to rainfall irregularities, negatively impacting on the stability of family farming developed by the communities settled in these regions (ANGELOTTI et al., 2009).

In the semi-arid region of Paraíba, sisal has a socio-economic aspect. According to Cavalcante and Almeida (2022), over the years this activity has responded as an alternative for keeping people in the countryside by generating income and employment, since much of the cultivation and harvesting is not mechanized or not very technical. Barreto et al. (2020) point out that the production chain involves a series of stages, such as planting, cultivation, extraction, processing and extraction, bringing numerous socio-economic benefits, but with an inevitable consequence, the production of waste, and scientific research has sought various solutions for agricultural

production to the detriment of the stability and quality of the environment.

In view of the above, the aim of this study is to highlight the socio-economic importance of sisal over the inter-annual period from 2009 to 2022 in the state of Paraíba, as well as the impact its cultivation has on agriculture. The aim was to find out about production fluctuations over the years and which variables contributed to this effect. In this way, we can discuss the evolutionary process of modernization with scientific advances in the development of techniques and their impact on the optimization of agricultural production of sisal (*Agave sisalana Perrine*).

MATERIALS AND METHODS

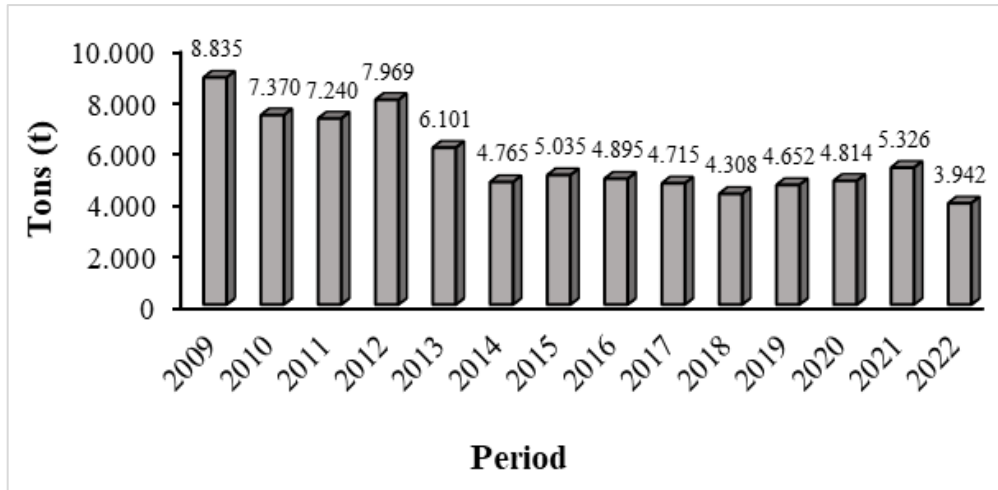
To this end, this study compiled results from the open-access public database of the Brazilian Institute of Geography and Statistics (IBGE) for the state of Paraíba over the inter-annual period from 2009 to 2022, considering the agricultural production of sisal (*Agave sisalana Perrine*).

In addition, a thorough search for manuscripts was also carried out on the “google academic” platform for works containing the keywords “sisal”, “*Agave sisalana Perrine*”, “family farming”, “sustainability”, “agricultural production”, “rural man” and “agribusiness”, resulting in several manuscripts, which were analyzed and compared with the essence of the respective study, thus being able to select the relevant works for the basis of this research.

RESULTS AND DISCUSSIONS

Looking at graph (1), the amount of sisal fiber produced in Paraíba over the years 2009 to 2022 has been falling dramatically, from 8.835 to 3,942 tons (t), with an approximate reduction of 55% compared to these period references. According to the Brazilian Agricultural Research Corporation - EMBRAPA (2014), one of the main causes of the reduction in sisal production, in addition to the droughts that affect the producing regions, the fungus *Aspergillus niger* or red rot has stood out over the decades, causing sisal trunk rot, reducing the crop's productive potential (GAMA et al., 2015). According to Brfertil (2016), with the constant demand for food, coupled with the large increase in the population, competition for arable land for food production, as well as areas earmarked for the agricultural sector, has become increasingly competitive, directly influencing the choice of cultivars used.

Graphic 1: quantity of sisal (*Agave sisalana Perrine*) produced in tons (t) in the interannual period from 2009 to 2022 in the state of Paraíba.



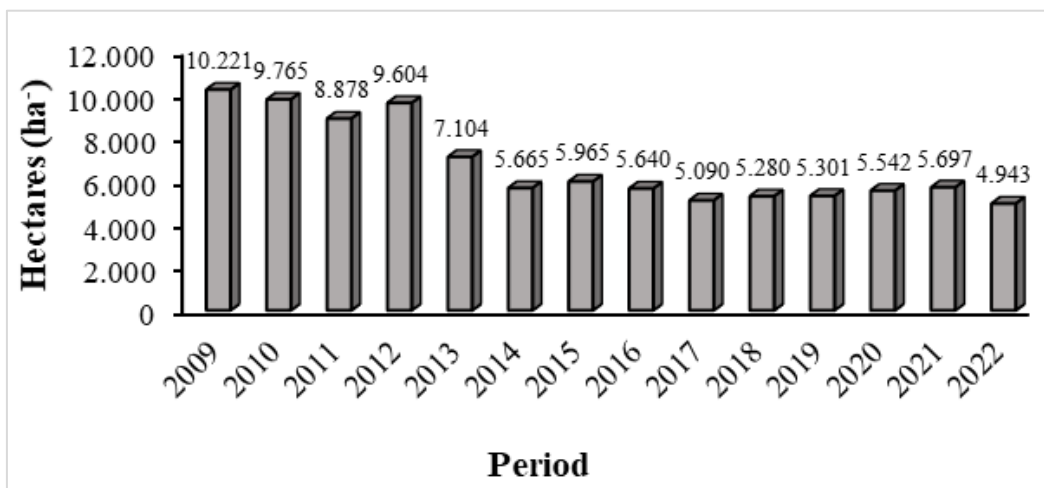
Source: adapted from IBGE (2023).

According to Martins (2001), Brazil stands out on the international stage, being the largest producer in the world, with the states of Paraíba (PB) and Bahia (BH) being the largest contributors, in addition, the country also stands out in terms of exports, with 70% of the processed sisal going to foreign markets, mainly to the Asian and European markets. Neves (2015) adds that in 2015 Brazilian exports generated US\$ 123.9 million worth of deal.

With regard to the area planted, graph (2) shows that from 2009 to 2013, with new areas, there was a

steady increase in the amount of land devoted to sisal production, standing at over 7.000 hectares (ha²), and despite a considerable decline, from 2014 to 2022 there was a steady increase, with an average of 5.458 ha². According to EMBRAPA (2006), several factors may be linked to these results, such as the initial cost of production, difficult intercropping with other crops, attacks by diseases and pests, soil factors and soil fertility. In addition, fiber production has an arduous competitor, the production of synthetic fibers, which has a strong impact on sisal production.

Graphic 2: Planted area in hectares (ha²) from 2009 to 2022 in the state of Paraíba.

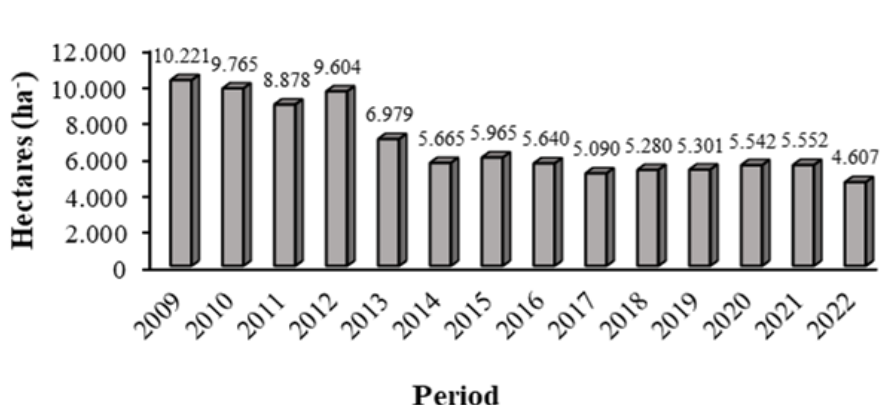


Source: adapted from IBGE (2023).

With regard to the area harvested, the graph (3) reveals a similar dynamic when compared to the area destined for planting, showing an average of 5.405 hectares (ha²) for the inter-annual reference period from 2009 to 2022. The fact is that sisal cultivation has been reduced. Silva et al. (2016), warns that despite satisfactory results for some years, family farming has run into difficulties, since monoculture pre-

vents consortium, leaving this producer very dependent on the success of the crop, weakening the economic support of his family nucleus.

Graphic 3: Harvested area in hectares (ha⁻¹) from 2009 to 2022 in the state of Paraíba.

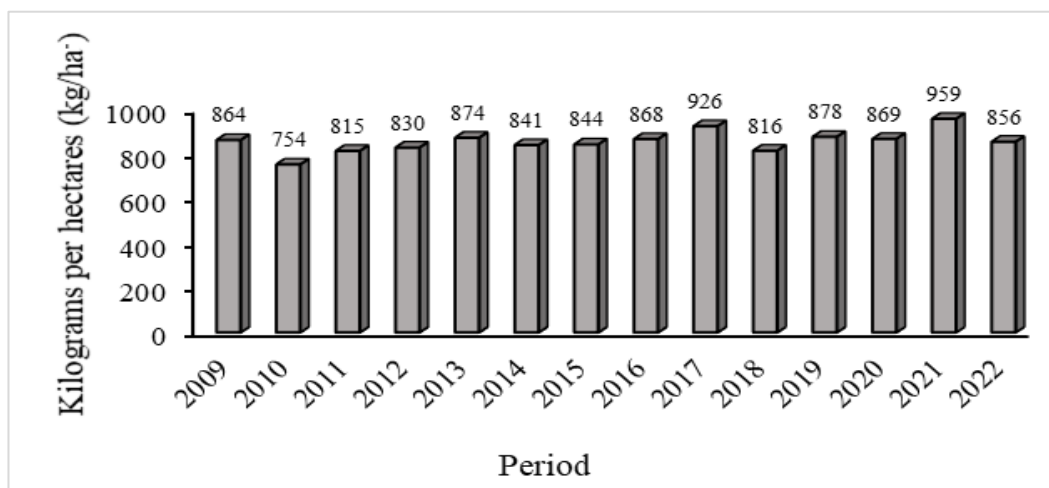


Source: adapted from IBGE (2023).

Despite the undeniable decline in the quantity produced, area planted and harvested for the period from 2009 to 2022, the average yield was 857 kg/ha⁻¹ (kilograms per hectare). This shows that despite the circumstances, the cultivar is very well used (Graph 4). According to Murali and Morchhale (2014), only 3 to

5% of sisal leaves are used, generating a large residual amount that can be used for animal nutrition, fuel formation, the pharmaceutical industry, fertilizers or other products (RIBEIRO et al. 2015). Damasceno et al., 2015 and Jesus et al., 2015 point out that despite its potential for various alternatives, most of the time the waste is just discarded, resulting in losses.

Graphic 4: Average yield kg/ha⁻¹ (kilograms per hectare) of sisal from 2009 to 2022 in the state of Paraíba.



Source: adapted from IBGE (2023).

CONCLUSIONS

In summary, the variables analyzed, such as quantity produced, area planted, area harvested and average yield for the inter-annual sample period from 2009 to 2022 for the state of Paraíba, show a sharp decline.

Throughout this study, the economic and social importance of sisal cultivation for agriculture was highlighted. Brazil is an international leader in the

production and export of fibers, with the state of Paraíba being one of the major contributors to achieving this level.

Despite constant technological advances, red rot caused by the fungus *Aspergillus niger* is still a strong indicator in the reduction of sisaleira areas, as well as severe droughts and competition for arable land, since

every year there is a greater demand for food production.

Finally, it can be concluded that it is necessary to constantly search for solutions through scientific research in order to improve the relationship between production, quality, sustainability and the rural man.

REFERENCES

- ANGELOTTI, F. et al. **Mudanças climáticas e desertificação no Semiárido brasileiro**. Petrolina, PE: Embrapa Semiárido, 2009.
- BARRETO, S. M. A. G. et al. In vitro and in vivo antioxidant activity of *Agave sisalana* agroindustrial residue. **Biomolecules**, v. 10, n. 10, p. e1435, 2020.
- BRFERTIL. **A importância dos fertilizantes para a produção de alimentos**. Disponível em: <<https://brfertil.com.br/importancia-dos-fertilizantes-na-producao-de-alimentos/>>. Acesso em: 22 out. 2023.
- CAVALCANTE, G. T. O.; ALMEIDA, H. A. Diagnóstico socioambiental do cultivo do sisal (*Agave ssp*) no recorte territorial de Pocinhos, PB. **Conjecturas**, v. 22, n. 8, p. 1092-1104, 2022.
- DAMASCENO, J. C. A., et al. Resíduo líquido de sisal (*Agave sisalana Perrine*) no controle do nematoide das galhas no tomateiro. **Horticultura Brasileira**, v. 33, n. 2, p. 155-162, 2015.
- EMBRAPA - EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA. **Informações gerais sobre o sisal. 2010**. Disponível em:<www.cnpa.embrapa.br>. Acesso em: 22 out. 2023.
- EMBRAPA. **Cadeia Produtiva do Sisal no Nordeste Brasileiro**. 2. ed. Brasília, 2014.
- EMBRAPA. **Sisal consorciado é alternativa para regiões secas. 2006**. Disponível em: <<http://www.embrapa.br>>. Acesso em: 25 set. 2023.
- FELIPE, L. O.; DIAS, S. C. Surfactantes sintéticos e biosurfactantes: vantagens e desvantagens. **Química Nova na Escola**, v. 39, n. 3, pp. 228-236, 2017.
- GAMA, E. V. S., et al. Homeopathic drugs to control red rot disease in sisal plants. **Agronomy for Sustainable Development**, v. 35, n. 2, p. 649-656, 2015.
- INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). **Censo Brasileiro de 2022**. Rio de Janeiro: IBGE, 2023. Disponível em: <<https://cidades.ibge.gov.br/brasil/pb/pesquisa/15/11863>>. Acessado em: 22 out. 2023.
- JESUS, F. N., et al. (2015). Control of the banana burrowing nematode using sisal extract. **Agronomy for Sustainable Development**, v. 35, n. 2, p. 783-791. 2015.
- MATEUS, E. R. **DEFIBRAMENTO DA *Agave sisalana* NO MUNICÍPIO DE CONCEIÇÃO DO COITÉ – BA: PROPOSTA DE APROVEITAMENTO DE RESÍDUOS SÓLIDOS**. 2017. 101p. Dissertação (Mestrado em Desenvolvimento Regional e Meio Ambiente) - Faculdade Maria MILZA – FAMAM, GOVERNADOR MANGABEIRA, BA, Brasil, 2017.
- MARTINS, M. A. **Fibra de Sisal: Mercerização, Acetilação e Aplicação em Compósitos de Borracha de Pneu Triturado**, Tese (Doutorado), Universidade Estadual de Campinas, Brasil, 2001.
- MURALI, S.; MORCHHALE, R. K. Sisal (*Agave sisalana*) Fibre **Extraction for Sustainable Employment Generation in India. Technologies for Sustainable Rural Development: Having Potential of Socio-Economic Upliftment**, p. 184-196. New Delhi: Allied Publishers Pvt. Ltd., 2014.
- NAVES, I. M. **Sisal 2015: Retrospectiva**. Conab- Companhia Nacional de Abastecimento, 2016. Disponível em: <<http://www.conab.gov.br>>. Acesso em: 18 de out. 2023.
- OLIVEIRA, A. F. L. **DESENVOLVIMENTO DE PLANTAS DE SISAL EM MANEJO SUSTENTÁVEL NO CURIMATAÚ PARAIBANO OCIDENTAL**. 2018. 36f. Trabalho de Graduação (Agronomia) - Centro de Ciências Agrárias, Universidade Federal da Paraíba, 2018.
- PROSSIGA. **Panorama do setor de sisal no Estado da Bahia. 2004**. Disponível em: <http://www5.prossiga.br/arranjos/vortais/sisal_ba_panorama1>. Acesso em: 22 out. 2023.
- QUEIROGA, V. P. et al. **Sisal (*Agave sisalana*, *Perrine*): Tecnologias de plantio e utilização**. Campina Grande: AREPB, 2021.
- RIBEIRO, B. D., et al. Use of micellar extraction and cloud pointpreconcentration for valorization of saponins fromsisal (*Agave sisalana*) waste. **Food and bioproducts processing**, v. 9, n. 4, p. 601- 609, 2015.
- SANTOS, E. M. C.; SILVA, O. A. Sisal in Bahia. **Brazil. Mercator**, v. 16, n. 12, p. 1– 13, 2017.
- SILVA, O. R. R. F.; BELTRÃO, N. E. M. **O agronegócio do sisal no Brasil**. Brasília-DF: Embrapa-SPI; Campina Grande/PB: Embrapa-CNPA, 1999.
- SILVA, F. P. M. O território do sisal. In: ORTEGA, A. C.; PIRES, M. J. S. **As Políticas Territoriais Rurais e a Articulação Governo Federal e Estadual: um estudo de caso da Bahia**. Brasília: IPEA, pp. 151-183, 2017.
- SILVA, F. P. M. et al. Arranjo produtivo local (APL): a experiência no território do sisal na Bahia. **Revista de Desenvolvimento Econômico**, v. 2, p. 523-554, 2016.
- TREJO-TORRES, J. C. et al. The Yucatan Peninsula is the place of origin of sisal (*Agave sisalana*, *Asparagaceae*): historical accounts, phytogeography and current populations. **Botanical Sciences**, v. 96, n. 2, p. 366, 2018.