RESR Revista de Economia e Sociologia Rural

ISSN 1806-9479

ARTICLE

Technological levels in pineapple (*Ananas comosus*) production in family agroecosystems in Novo Remanso (Itacoatiara/Amazonas)

Níveis tecnológicos na produção de abacaxi (Ananas comosus) em agroecossistemas familiares de Novo Remanso (Itacoatiara/Amazonas)

Silvia Tavares Maia[1], Tiago Viana da Costa[2], Francimara Souza da Costa[3]

[1] Instituto de Ciências Exatas e Tecnologia (ICE), Programa de Pós-graduação em Ciências e Tecnologias para Recursos Amazônicos (PPGCTRA), Universidade Federal do Amazonas (UFAM), Itacoatiara (AM), Brasil. E-mail: silviamaia79@hotmail.com
[2] Instituto de Ciências Sociais, Educação e Zootecnia, Programa de Pós-Graduação em Ciências e Tecnologias para Recursos Amazônicos (PPGCTRA), Universidade Federal do Amazonas (UFAM), Parintins (AM), Brasil. E-mail: tvianadacosta@yahoo.com.br
[3] Faculdade de Ciências Agrárias, Programa de Pós-graduação em Ciências e Tecnologias para Recursos Amazônicos (PPGCTRA), Universidade Federal do Amazonas (UFAM), Manaus (AM), Brasil. E-mail: francimaracosta@yahoo.com.br

How to cite: Maia, S. T., Costa, T. V., & Costa, F. S. (2024). Technological levels in pineapple (*Ananas comosus*) production in family agroecosystems in Novo Remanso (Itacoatiara/Amazonas). Revista de Economia e Sociologia Rural, 62(2), e269860. https://doi.org/10.1590/1806-9479.2022.269860

Abstract: In Amazonas, family farming uses the environmental system for subsistence, with its production destined primarily for self-consumption and the surplus destined for sale. Considering the peculiarities of the distinguishing features of the region and the characteristics of family farmers, the use of technologies could probably expand agricultural products sold on the market. This study aimed to evaluate the sustainability of family agroecosystems of pineapple producers in Novo Remanso, AM, Brazil, through the technologies used. Semi-structured forms were applied through interviews with 30 farmers associated with the Cooperativa Agropecuária de Novo Remanso [COOPANORE]. The analyzed components were the use of machines, equipment, and tools; selection of seedlings; fertilizing; planting; cultivation treatments; and harvest/post-harvest technologies. The technological index was determined individually for each technology and together, and the closer to the recommended technology, the better the technological level. The farmers interviewed use more than 50% of the recommended technologies, representing standard B, except for seedling selection and harvest/post-harvest technologies, which presented level C. Even with the increase in production, the use of technologic did not solve the problem of pineapple commercialization, showing that technologies need to be accompanied by organizational factors related to production.

Keywords: family farming, production system, socioeconomic and institutional aspects.

Resumo: No Amazonas, a agricultura familiar usa o sistema ambiental para a manutenção da vida, sendo sua produção destinada, prioritariamente, ao autoconsumo e o excedente é destinado à comercialização. Considerando as peculiaridades da região e as características dos agricultores familiares, se pressupõe que com a utilização de tecnologias é possível ampliar a inserção dos produtos no mercado. Este estudo teve como objetivo avaliar a sustentabilidade de agroecossistemas familiares, de produtores de abacaxi de Novo Remanso/AM, mediante as tecnologias utilizadas. Para tanto, foram aplicados formulários semiestruturados, por meio de entrevistas a 30 agricultores associados da Cooperativa Agropecuária de Novo Remanso [COOPANORE]. Os componentes analisados foram: uso de máquinas, implementos e ferramentas; seleção de mudas; adubação; plantio; tratos culturais e colheita/pós-colheita. O índice tecnológico foi determinado individualmente para cada tecnologia e em conjunto, sendo que quanto mais próximo da tecnologia recomendada melhor o nível tecnológico. Foi verificado que os agricultores utilizam mais de 50% das tecnologias recomendadas, representando padrão B, exceto as tecnologias seleção de mudas e colheita/pós-colheita, que apresentaram padrão C. Mesmo com o aumento da produção, a inserção tecnológica não resolveu o problema da comercialização do abacaxi, evidenciando que as tecnologias precisam vir acompanhadas de fatores organizacionais relativos à da produção.

Palavras-chave: agricultura familiar, sistema de produção, aspectos socioeconômicos e institucionais.

1. Introduction

According to the Instituto de Desenvolvimento Agropecuário e Florestal Sustentável do Amazonas – [IDAM] (Instituto de Desenvolvimento Agropecuário e Florestal Sustentável do Amazonas, 2019), 90% of rural producers (42,334 individuals) in the state of Amazonas are classified as family farmers. Of this total, 78.57% are farmers, 15.10% breeders, 4.75% fishermen, and 1.61% extractivists. Among family farmers, 60.6% are men, 37.6% are women, and 1.70% are young people. According to Law 12,852 (Brasil, 2013), young people are defined as between 15 and 29 years old.

To understand the place of family farming in Amazonas, elements that must be considered include the agrarian structure, the physical and institutional environment in which it is inserted, the limited land used for agricultural development, the technology that is used and could be used, and the possible innovation process. The efficiency of production processes can be improved through technological innovation, resulting in greater production, income, and quality of life (Silva et al., 2013).

This study aimed to analyze the technologies employed by family farmers for pineapple cultivation in Novo Remanso, a district of the municipality of Itacoatiara in the state of Amazonas. This location was chosen because it is the largest pineapple-producing region in the state (Instituto de Desenvolvimento Agropecuário e Florestal Sustentável do Amazonas, 2019). According to the IDAM, 68.9 million units of fruit (73.0%) of the 94.3 million units of pineapples produced in Amazonas in 2019 came from Novo Remanso.

This scale of production was achieved using different technological levels and the natural soil conditions in this location that contribute to the ideal organoleptic characteristics of pineapple (low acidity and sweetness). The product is popular with consumers, making the state of Amazonas the second largest pineapple producer in the Northern Region (Instituto de Desenvolvimento Agropecuário e Florestal Sustentável do Amazonas, 2020).

According to the Instituto de Desenvolvimento Agropecuário e Florestal Sustentável do Amazonas (2012), the success of Novo Remanso in pineapple production is due to the cultivation techniques that include mechanization, modern inputs, and integrated pest monitoring. These improvements in the local production process have produced higher plant stands, providing increased productivity and fruit supply throughout the year, as well as increasing the income of family farmers.

In this context, analysis of the technological level employed in these family agroecosystems is important to define the extent to which the technologies used are appropriate to the region, considering the farmers' profile. The research helps identify the technologies used in pineapple cultivation, providing visibility to the aspirations of Novo Remanso producers. This information could enable the sectors responsible for public policies to improve strategies based on local knowledge and reality.

2. Theoretical background

Amazonian agroecosystems are characterized by family-based production systems raising a variety of crops within the national scenario in which agriculture is responsible for the production of most of the food necessary to feed the population (Alves et al., 2018). However, the introduction of technologies to increase production leads to worries about environmental, cultural, and social issues (Andrade, 2012).

The technological innovation generated by research centers, combined with the technologies resulting from the knowledge accumulated by family farmers, allows significant improvements in production, with cultural preservation as well as environmental and social sustainability. Innovation can occur through changes in a production process, services that benefit that process, or technology introduced into the production process. However, although some technologies significantly impact production, they make the farmer more dependent on factors external to the property (Meneghetti & Souza, 2015).

According to Balsadi et al. (2002), a high technological level involves production systems with extensive mechanization of cultivation (soil preparation, planting, cultivation treatments, harvest and post-harvest). In addition, planning the use of machinery is essential to minimize costs and losses, improve working capacity, and employ technologies more efficiently.

Agroecosystems that use a low level of technology have changed little since they began, either due to the farmers' limited theoretical information or lack of access to technologies. However, they meet social needs because they are built on practical knowledge of the environment (Abiko, 2003).

For Meneghetti & Souza (2015), the use of traditional technologies does not mean that the production system in question is "backward" in technological terms. All the technological innovation possible is incorporated over time, in that environment, in that culture, and with the means available. For development and technological innovation to occur in Amazonas, cultural and educational barriers of the population also must be overcome, as well as the financial limitations of families. Furthermore, there needs to be better cooperation between actors; research, innovation, training institutions; and economic agencies in the sectors involved.

Most agricultural establishments in the Amazonia region use the traditional system of agriculture, called the "slash and burn system," which generates some environmental damage. This system is characterized by the continuous use of the land, which varies from one to two years, and then left to lie fallow and crops moved to new areas (Matos et al., 2019).

Thus, family farming in Amazonia continuously undergoes adaptation processes, seeking a balance between agricultural activity, economic needs, social factors, cultural aspects, and environmental problems. The inclination for sustainability is also observed in the adoption of practices with less environmental impact and minimal use of chemical and industrial inputs (Paiva et al., 2019).

In Amazonas, family farmers adopt occupation of space and use the environmental system to maintain family life, with agricultural production intended primarily for self-consumption, and the surplus is intended for commercialization. Products not generated in the family production unit and services not available in the community are accessed through the monetary income earned in the commercialization of the surplus, establishing a specific and unique relationship of environmental conservation (Noda et al., 2013).

Family farming was defined by Law No. 11,326 of July 24, 2006 (Brasil, 2006) as agriculture carried out with labor mostly by members of the nuclear family. The rural producer manages the work himself, and the cultivation of the land is carried out on properties with a size of up to four fiscal modules, which, according to the National Institute of Colonization and Agrarian Reform [INCRA] (Instituto Nacional de Colonização e Reforma Agrária, 2020a, 2020b), is 80 ha in the region of Itacoatiara, AM.

Considering the physical environment, the local culture, the dispersion of the population throughout the territory, and the characteristics of Amazonian farmers, our hypothesis is that technologies could increase the availability of family farming products on the market in Amazonas, maintaining the local culture and the conservation of natural resources. This process will help boost the rural economy, increase labor productivity via rational mechanization, make the grueling work more humane for farmers, and improve the quality of life and well-being in rural communities (Meneghetti & Souza, 2015).

3. Methodology

3.1. Area Studied

The study was conducted in agroecosystems of pineapple producers in Novo Remanso (3° 12' 30" S 59°00' 00" W), a district in the municipality of Itacoatiara, AM, Brazil. The area is about 100 km from the city of Itacoatiara, accessed by highway AM-010 until the intersection with the municipal access road to the district (Figure 1).

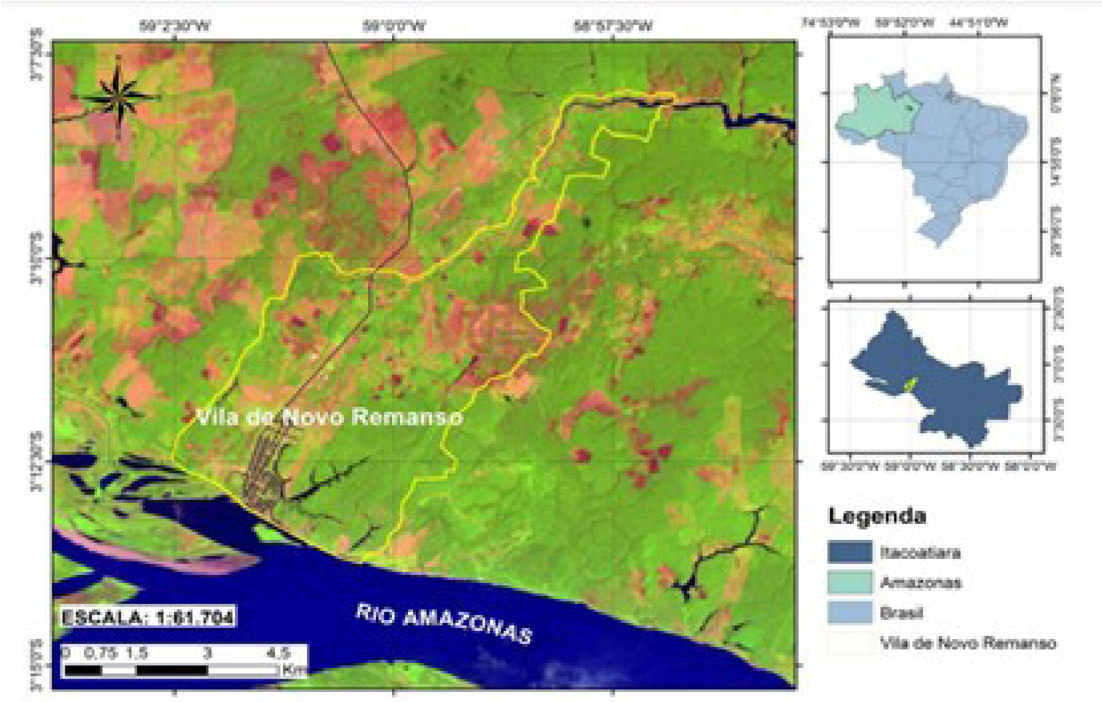

Figure 1. Location of the study area – Novo Remanso. Legenda = subtitle; Itacoatiara = Itacoatiara; Amazonas = Amazons; Brasil = Brazil; Vila de Novo Remanso = Village of new backwater; Rio Amazonas = Amazon River; escala = scale.
Source: Alfaia (2019).

3.2. Data collection

Primary data were collected through local observation and application of predefined forms, in direct interviews with producers (Marconi & Lakatos, 2007, p. 214), between November 2021 and March 2022. The interviews were conducted in the producers' homes and properties, in an open place, and at previously scheduled times to not disturb domestic and work activities.

Due to the risk of spreading the new Coronavirus, safety procedures were used when conducting the research, including masks and alcohol gel researchers and participants. A distance of two meters was maintained, according to the guidelines of the contingency plan of the Federal University of Amazonas, during the COVID-19 pandemic. The research was submitted to and approved by the Research Ethics Committee of the Federal University of Amazonas (CEP/UFAM) under registration No. 50560121.4.0000.5020. All interviewees signed the Informed Consent Form (ICF) in accordance with Resolution No. 510 (Brasil, 2016).

The bibliographic data were obtained from scientific publication platforms and secondary data from public websites of specialized agencies such as the Brazilian Institute of Geography and Statistics (IBGE), IDAM, EMBRAPA, and COOPANORE.

The research subjects were the pineapple producers of Novo Remanso, who were associated with the cooperative COOPANORE – Cooperativa Agropecuaria do Novo Remanso Coopanore. To ensure the normality of the data (Callegari-Jacques, 2003), the sample consisted of 30 producers out of a total of 53 cooperative members (56.6%), contacted and selected from a list obtained from the cooperative.

Producers who met the following criteria were included in the research: a) have property located in the area with an extensive expansion of pineapple growing; b) have pineapple cultivation as their main income; c) use family labor; d) have been growing pineapple for at least 10 years; e) supply their production to COOPANORE.

3.3. Analysis method

3.3.1. Definition and Operationalization of the variables that encompass the technological level of pineapple producers

The identification of technological levels in pineapple production was based on studies conducted by Oliveira (2003), Freitas et al. (2004), Gonçalves (2011), Santos (2012), and Barbosa & Souza (2013). The components of the production system considered included: 1. Use of machinery and equipment; 2. seedling selection; 3. fertilization; 4. planting; 5. cultivation treatments; 6. harvest and post-harvest.

The technology indicators and variables were adapted from the recommendations of Silva et al. (2004) and Teixeira et al. (2020). For each variable included in a given technology, a score was assigned according to its use and efficiency (Oliveira, 2003), as shown in Table 1.

Table 1. Scores used in the operationalization of the use of machinery, equipment, and tools; seedling selection; fertilization; planting; cultivation treatments; and harvest/post-harvest.

Variables	Value		Variables	Value	
	Used	Not Used		Used	Not Used
X_1 – Tractor		0	X_{16} – Curing	1	0
- Leased/serviced	1		X_{17} – Soil analysis	1	0
- Own	2		X18 – Soil treatment	1	0
X_2 – Plow		0	X_{19} – Fertilization	1	0
- Leased/serviced	1		X_{20} – Manually cover the soil	1	0
- Own	2		X_{21} – In the axil of plants	2	0
X_3 – Grade		0	X_{22} – Stage of development	3	0
- Leased/serviced	1		X23 – In holes	1	0
- Own	2		X_{24} – In furrows	1	0

Source: Adapted from Freitas et al. (2004) and Oliveira (2003).

Table 1. Continued...

Variables	Value		Variables	Value	
	Used	Not Used		Used	Not Used
X_4 – Tiller		0	X_{25} – Double spacing	1	0
- Leased/serviced	1		X_{26} – Single spacing	2	0
- Own	2		X_{27} – Weed control		0
X_5 – Cart		0	- other periods	1	0
			- Up to six months after planting	2	
- Leased/serviced	1		X_{28} – Manual weeding	1	0
- Own	2		X_{29} – Mechanical weeding (brushcutter)	2	0
X_6 – Brushcutter		0	X_{30} – Chemical (Herbicide)	3	0
- Leased/serviced	1		X_{31} – Floral Induction (Ethefon 10 ml/100 L)		0
- Own	2		-Other periods	1	
X_7 – Truck		0	-5 months from planting	2	
- Leased/serviced	1		X_{32} – Pest and disease control		0
- Own	2		- Cultural	1	
X_8 – Costal sprayer		0	- Chemical	2	
- Leased/serviced	1		X_{33} – Pest control: *Strymon basalides*	1	0
- Own	2				
X_9 – Wheelbarrow	2	0	X_{34} – Pest control: *Dysmicoccus brevipes*	1	0
			X_{35} – Pest Control: *Thlastocoris laetus*	1	0
X_{10} – Plastic bucket	2	0	X_{36}-Disease control: *Phytophthora nicotiana*	1	0
X_{11} – Hoes and machetes	2	0	X_{37} – Harvest points		0
X_{12} – PPE		0	- Other harvesting points	1	
- Some items	1		- Harvesting at the first signs of yellowing of the skin	2	
- All items	2		X_{38} – Harvest		0
X_{13} – Origin of seedlings		0	- Without peduncle	1	
- Straight from the field	1	0	- With peduncle	2	
- Nursery	2		X_{39} – Disinfection of the peduncle	1	0
- Tissue culture	3	0	X_{40} – Classification of fruit	1	0
X_{14} – Ceva	1	0	X_{41} –Packing on the crown of the preceding fruit	1	0
X_{15} – Phytosanitary treatment	1	0	X_{42} – Refrigerated trucks	1	0

Source: Adapted from Freitas et al. (2004) and Oliveira (2003).

3.1.2. Measuring the level of technology

To evaluate the level of technology, an index was determined for each farmer in each of the components that formed that level by Equation 1 (Miranda, 2001).

$$In_j = \sum_{i=y}^{m} \frac{a_i}{w_n}$$

being, $w_n = max \sum_{i=y}^{m} a_i, therefore, 0 \leq ln_j \leq 1$

in which:

In_j = Index of each technology *n* of farmer *j*

i= Variables used;

n = Technology used;

[y, m] = variables within segment i referring to technology *n*;

a_i= represents the value of adopted element x_i of technology n;

Thus, $\frac{a_i}{w_n}$ represents the weight of each element x_i in the constitution of the specific technological index n, and

for machinery, equipment, and tools technology	n = 1, i = [1;12] and w_1 = 24
for seedling selection technology,	n= 2, i = [13,16] and w_2 = 6
for fertilization technology,	n = 3, i = [17;22] and w_3 = 10
for planting technology,	n = 4, i = [23;26] and w_4 = 4
for cultivation treatment technology,	n = 5, i = [27;36] and w_5 = 16
for harvest and post-harvest,	n = 6, i = [37;42] and w_6= 8

The mean specific technological index for the set of farmers is given by the sum of the specific indices of individual farmers, divided by the number of farmers interviewed, demonstrated by Equation 2:

$$IT_n = \frac{1}{z} \sum_{j=1}^{z} ln_j$$

in which:

j = Number of farmers (ranging from 1 to z)

n = Technology used;

The overall technological index of a farmer, including all technologies, can be obtained by Equation 3:

$$IP_{nj} = \frac{1}{6} \sum_{1}^{6} ln_j$$

Thus, the technological index of pineapple production in the study area, considering all producers, will be expressed by Equation 4:

$$GI = \frac{1}{J} \sum_{1}^{J} IP_j$$

These indices range from 0 to 1, and the closer to 1, the better the technological level of the farms. The comparison between the technological levels was based on the studies of Matos (2005), with the following classification:

Level A: High technological level – farmers employing more than 80% of the recommended technology;

Level B: Intermediate technology level – farmers adopting more than 50% of the recommended technology;

Level C: Low technology level – farmers using up to 50% of the recommended technology.

The technological level was analyzed based on the previously defined standards. The farmer's technological index (In_j) and the mean technological index of farmers (IT_m) were used in relation to a given technology and the relative frequency of responses in relation to the variables that compose each technology, followed by a discussion of the overall technological index.

4. Results and discussion

4.1. General characterization of pineapple producers in the district of Novo Remanso

According to the results obtained, most of the producers are between 34 and 42 years old (70.0%). Although labor is predominantly done by the family, they employ some temporary outsourced labor for the specific activities inherent to pineapple production, such as harvesting, planting, floral induction, and weed control. The need for this assistance is also related to the size of the property, i.e., the larger the area, the greater the need for workers. This local employment helps keep residents in Novo Remanso. According to Moreira & Sene (2016), family farming is the main source of employment in the countryside and reduces the migratory flow to the cities.

According to the National Confederation of Agriculture [CNA] (Confederação Nacional da Agricultura, 1999), a high percentage of young producers (15 to 29 years) in a rural area may indicate the expectation for the longevity of the activity. However, when a high proportion of farm managers are over 60, the reduction in the physical strength needed for farm work is detrimental to productivity.

This scenario in Novo Remanso differs from most rural areas in the Amazon and Brazil since studies have found that men/women are generally older in family farming (Dickel & Zanella, 2020, p. 247). On the one hand, public policies related to socioeconomic issues, such as rural retirement and health insurance, have increased men's permanence in rural areas. On the other hand, the lack of incentives for young people to remain, for example, education and income opportunities, promotes their exodus to urban centers, especially women, compromising succession in rural establishments and interfering in the social and productive dynamics of the rural space (Oliveira et al., 2021). According to Zago (2016), selective migration has strongly impacted family farming.

Regarding educational level, 53.3% of producers in Novo Remanso have completed high school. This is probably because the community has a high school, which is not typical in rural areas of Amazonas, where most residents only have an elementary school education due to the lack of local schools that offer subsequent levels (Gomes & Nogueira, 2022). The low educational level is a reality of rural areas in the Northern region. According to A2015 Amazonas State Education Plan (PEE), residents of rural areas were at a sociocultural disadvantage compared to residents of urban areas, with lower levels of education, difficulties in accessing education, poor infrastructure, and lack of financial resources.

Our study observed that 96.7% of the producers own their homes which have 4 to 6 rooms. This is because two families usually live in the same house: parents, children, daughters-in-law or sons-in-law, and grandchildren, requiring homes with as many rooms as possible. According to Wolf (1970), families can be classified in family farming as nucleated (composed exclusively of spouses and children) or extended (groups of other nuclear families living in the same structure). In the case of Novo Remanso, the extended family type prevails, contrary to the results of Fraxe et al. (2007), which found that the majority of families in family farming in communities in the middle Amazonia were nucleated type.

Pineapple cultivation is the only economic activity of 46.7% of the respondents. The rest also grow other species, such as passion fruit (*Passiflora edulis*), chili pepper (*Capsicum chinense*), and elephant grass (*Pennisetum purpureum* Schum) for livestock. Producers also complement their income with other non-agricultural activities (53.3%), such as commerce and public service, creating strategies to increase income. This plurality of activities is an intrinsic characteristic of family farming in Amazonas (Nascimento et al., 2022).

The average income observed among producers in Novo Remanso is two minimum salaries. This is higher than the average income of agricultural labor, which in Brazil is less than 25.0% of the minimum wage. However, producers reported that their incomes were higher before the pandemic, due to the guaranteed market for pineapple production. According to Instituto Brasileiro de Geografia e Estatística (2021), from 2012 to 2021, the per capita household income in Brazil dropped by 6.9%, explained by the change in the criteria for receiving emergency aid and the impact of inflation. In the Northern region, the average monthly family income was R$ 871.00, and R$ 303.00 among rural producers, which is well below the minimum wage in 2021 of R$ 1,212.00.

Concerning rural credit, 60.0% of respondents reported that they obtained credit through Banco da Amazônia (BASA) in 2010 and 2011. However, many producers were unable to pay the financing and were then unable to apply for new loans. The twelve producers who did not receive any financing reported that bureaucratic issues (documentation) were the main obstacles. Oliveira (2003) also observed that bureaucracy is the main bottleneck for receiving financing for pineapple producers in Novo Remanso, confirming the same situation in the national scenario (Cruz et al., 2020).

With regard to technical assistance, Novo Remanso stands out because of the sample studied, because 76.6% received technical assistance, both public and private/own, unlike the reality presented in the Northern region, where only 7.0% of the total rural establishments and 7.0% of the total area of the region have Technical Assistance and Rural Extension - (ATER) coverage (Pereira & Castro, 2021). Continuous technical assistance is an indispensable service to improve production, including the possibility of reducing costs and increasing profitability. However, only 20.0% of agricultural establishments in Brazil (5,073,324), of which 77% are family establishments, have access to technical assistance. This is even lower in the Northern and Northeastern regions, which hurts the production of many small producers (Instituto Brasileiro de Geografia e Estatística, 2017).

Regarding the condition of use and possession of the land, 73.4% of the producers are landowners, 23.3% use the land as tenants, and 3.3% as squatters. The total area of 60.0% of the properties is between 5 and 10 ha; 26.6% are 11 to 50 ha; and only 3.3% are larger than 50 ha. In 83.3% of the pineapple-producing units, the area planted with the crop is 1 to 5 ha, while 13.3% plant between 6 and 10 ha, and 3.3% have cultivated area between 21 and 30 ha.

Therefore, although most producers have areas larger than 5 ha, they use only part of the area for pineapple planting. According to producers, the planted area has decreased since 2020, due to the lack of market for commercialization resulting from the pandemic. Due to the high losses of the product, they reduced the areas planted with pineapple to reduce losses.

The study found that 10.0% of the producers have cultivated pineapple for a maximum of 5 years, 60.0% cultivate between 6 and 10 years, and 3.3% for more than 10 years. However, 80.0% of the producers expressed negative expectations regarding marketing in the coming years, including stating that they intend to give up the activity if there is no change in the situation regarding the lack of contracts for the purchase of the product. The main problem observed was the increase in the cost of production because of the increased price of inputs. They reported that in the month of December 2021, for example, the bag of NPK fertilizer cost R$ 180.00, but in March 2022, this price increased to R$ 300.00, making production economically unviable.

4.2. Technology level determined

The pineapple variety grown in Novo Remanso is Turiaçu, which came from Maranhão to Amazonas and is well adapted to the region. Its organoleptic characteristics are liked by consumers (size, color, flavor, and aroma). In Amazonas and Maranhão, the agronomic aspects of this variety have not been well studied, such as nutritional requirements, floral induction, and seedling production. Cultivation in Amazonas has been done with technologies recommended for the Pérola cultivar, such as planting in double rows, application of floral inducers, soil preparation, and chemical fertilization (Garcia et al., 2013). Therefore, the technological index used in this study was adapted from the recommended technologies for the Pérola cultivar.

Figures 2, 3, 4, and 5 represent the technological levels of each technology for the set of producers, as well as the technological level for each property (IT_m), the contributions of each technology in the general technological index (GI), and the GI.

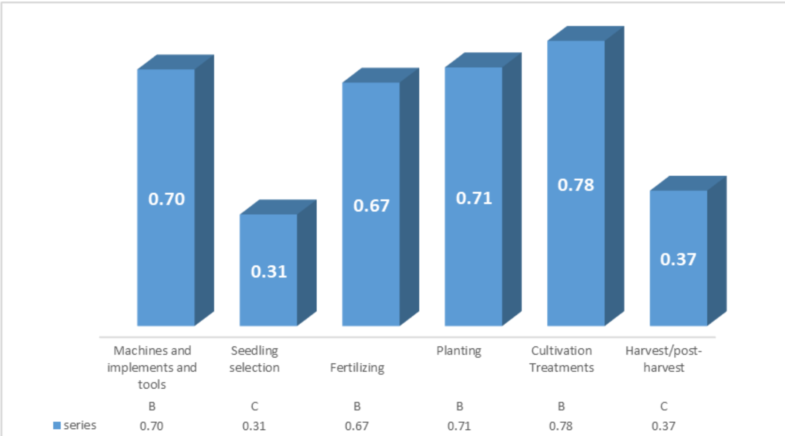

Figure 2. Mean Technological Index (IT_m) for the technologies: 1. Machinery, equipment, and tools; 2. Seedling selection; 3. Planting; 4. Fertilization; 5. Cultivation Treatments and harvest/post-harvest adopted by producers.

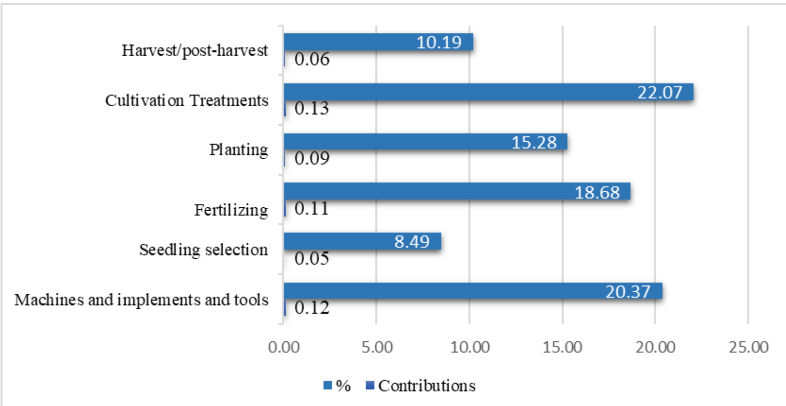

Figure 3. Contribution of technologies to the general technological index (GI).

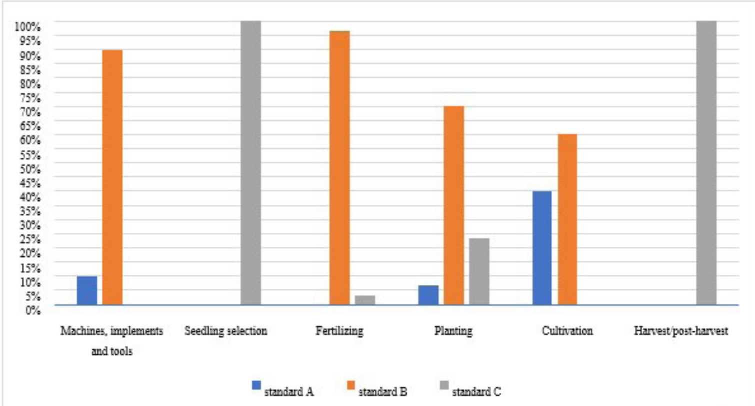

Figure 4. Levels of technologies adopted in pineapple production in Novo Remanso, AM.

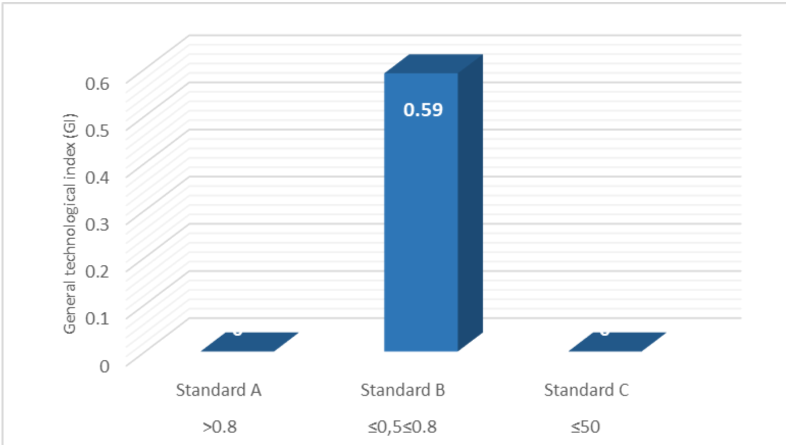

Figure 5. General Technological Index (GI) of pineapple producers.

Technology of machines, equipment, and tools

The mean index for this technology was 0.70, which is Level B, intermediate level. Soil preparation service is contracted by most of the farmers from the same producer who owns the machinery and equipment. For those who do not have their own vehicle, their production is transported using the truck of the COOPANORE. However, this is not currently viable, as they need to pay around R$ 1,500.00 per trip to take the production to Manaus.

According to Gomes & Walter (2023), the processes of change from incorporating technologies in the various stages of agricultural production, particularly mechanical ones, replace field labor. Mechanization makes the work of the producer/rural worker less painful and arduous, as one man can produce much more using a tractor, a harvester, a thresher, a conveyor belt, a new flow of operations, a motorized sprayer instead of using manual labor in the cultivation of smaller plants (Lima, 2021). Production planning with machine use helps minimize costs and losses while also improving work capacity, making its use more efficient. However, environmental and socioeconomic issues must be considered in the use of these technologies, especially related to global warming and directing family farming to the market (Souza et al., 2019).

Seedling selection technology

This technology obtained an mean technological index of 0.31, falling within level C. All producers use seedlings taken directly from the field but do not proceed with ceva. No producers purchase seedlings from nurseries or tissue culture. Of the respondents, 56.7% do the phytosanitary treatment, and 43.3% expose the seedlings to the sun (curing). This technique accelerates the healing of the lesion resulting from the cut, reducing the population of mealybugs and eliminating excess moisture (Teixeira et al., 2020). A technique that contributes to plant uniformity, which Brazilians call ceva, consists of keeping the seedlings on the plants after harvesting the fruit until the seedlings reach the ideal size for planting. Proper selection of a seedling is important for the health and uniformity of planting (Silva et al., 2004).

Phytosanitary problems have been the main cause of the low supply of quality seedlings to pineapple producers. The production of seedlings through the technique of stem sectioning (nurseries) has been shown to efficiently obtain materials free of pests and diseases, as well as the tissue culture technique. Because they are obtained in an aseptic environment, micropropagated seedlings have excellent health (Matos et al., 2009). Queiroz (2013) tested different substrates for the growth of buds of stem sections of the Turiaçu pineapple variety and found that this could be a way to obtain healthy seedlings quickly.

Fertilization technology

The technological index obtained for fertilization was 0.67, constituting level B. All of the producers use chemical fertilization, both when planting and top dressing. However, these fertilizers are applied between the rows directly on the soil and not in the axils of the leaves, which would be the most efficient method for the absorption of nutrients to avoid losses (Gomes et al., 2003). The study found that 100.0% of the producers fertilize during the plant development stage. Although 73.3% have at some point requested soil analysis, they have not received the result from the extension agencies in the region. Following recommendations from each other’s experiences, 93.3% carry out soil correction.

The producers’ lack of knowledge of the soil and the nutritional requirements of the crop leads to inadequate fertilization. Overapplication of fertilizers could increase the cost of production due to the purchase of inputs. Despite the frequent use of chemical fertilizers, most producers lack specific technical guidance regarding the necessary doses, especially of nitrogen and potassium (Garcia et al., 2013).

Planting technology

The technological index obtained for the planting technology was 0.71, constituting technological level B. The predominant form of planting for 70.0% of the producers is in furrows, 30.0% plant in holes, 70.0% plant in single spacing, and 30.0% use double spacing. According to Teixeira et al. (2020), the spacing used in pineapple cultivation varies according to the cultivar, the destination of production, and the level of mechanization.

More dense plantings with double spacing provide higher yields, but individually the fruits reach lower weights (Silva et al., 2004). As the production in Novo Remanso is directed to *in natura* consumption of the fruit, 70.0% of the producers prefer single spacing, which guarantees larger fruits. The furrow production method is used because it requires less labor and facilitates the planting process.

Cultivation treatment technology

This technology had a mean technological index of 0.78, falling within the range of level B. The cultivation treatment technology was divided into control of weeds, floral induction, and management of pests and diseases. All of the producers control weeds in the first six months after planting, and no producer performs only manual control; 30.0% use mechanical control (manual brushcutter); 70.0% use chemical control; and 40.0% employ all three weed control methods.

The pineapple tree grows slowly. Its superficial root system makes it very sensitive to competition from weeds, which can delay crop development and reduce production. For these reasons, the crop should always be kept clean, especially in the first five to six months after planting (Reinhardt et al., 2000).

All producers perform flower induction between eight and twelve months after planting. This is different from what Reinhardt et al. (2000) recommended, which is five months after planting. The application of phytoregulators is essential for good management and economic success in pineapple cultivation. When well planned and executed, it allows better distribution of operations and use of labor on the property, as well as harvesting fruit at more favorable times for sale.

Phytosanitary control against pests in pineapple production is carried out by 100% of producers in a chemical way. The main pests occurring in the region were described in the work of Garcia et al. (2013), highlighting the mealybug *(Dysmicoccus brevipes)*, whose importance is due to its association with the virus-caused wilt; the pineapple flat mite (*Dolichotetranychus floridanus)*; the pineapple fruit borer *(Strymon megarus)*, and the pineapple bug *(Thlastocoris laetus)*. No producer carries out disease control because, according to the interviewees, there are diseases in the crops.

The Turiaçu variety grown in Amazonas and Maranhão seems to be tolerant to the fusarium disease (*Fusarium guttiforme*), one of the main limiting factors of national pineapple production. So far, symptoms of fusarium wilt have not been observed for this variety in Amazonas (Araújo et al., 2012).

Harvest/post-harvest technology

The technological index obtained in these steps was 0.37, corresponding to level C. All the producers harvest when the peel turns yellow. Pineapples do not ripen satisfactorily after harvest, compromising quality and commercialization; therefore, the crop must be harvested after complete physiological development. Fruits should be harvested at different stages of ripeness according to destination and distance from the consumer market. For the fresh market (the main destination of commercialization in Novo Remanso) and distant markets, the fruits must be harvested "*de vez*" (as it is called in the local lingo), which is when the first signs of yellowing of the peel appear (Teixeira et al., 2020). To harvest the pineapples, 97.0% of producers cut them with 5 cm of the peduncle, which according to Silva et al. (2004), prevents infection by diseases.

All of the producers grade their produce. This classification is divided into "*ferrão*" (large), medium, and "*chibiu*" (small). The transportation of the production is carried out by 27.0% of the producers in the COOPANORE truck without refrigeration. One of the reasons why this technology presented a low technological index was that producers did not adopt the appropriate techniques for packaging the fruit in the truck and did not use refrigerated trucks. These techniques could reduce losses, prolong the shelf life of the fruit, and avoid the need for varieties with improved characteristics to withstand transportation over long distances.

Another problem observed at this stage was the current selling price of pineapple in the markets of Manaus, which does not cover the current production costs of the crop. According to the secretary of the COOPANORE cooperative, the cost per unit of fruit was R$ 1.20 in 2021, and it was marketed for R$ 1.30, with occasionally obtaining prices around R$ 3.00. High fruit loss (8–10%) also contributes to low profitability, mostly due to inadequate storage and transportation. The problem of high input prices in the region contributes to increased production costs. According to Carvalho & Lacerda (2005), reducing as much as possible the period from harvesting and processing the fruits to storing and transporting the fruits under refrigeration conditions (at temperatures close to 12 °C) are strategies that could reduce losses.

These findings are in line with the technologies desired by producers, where 83.33% stated that one of the biggest obstacles in pineapple production is marketing, as the fruit does not hold up to transportation over long distances, which hinders export to other states, restricting marketing only to local fairs and Manaus. This problem is leading to the migration of most producers to the cultivation of other species, such as passion fruit, banana, and cattle both for beef and milk production.

Oliveira Neto (2020) stated that the main problems of pineapple marketing in Brazil are distance from large consumer centers, diversity and competition from other fruits, concentrated or diffuse supply, low organization of producers, asymmetry of information, perishability and competitiveness, and consumer eating habits and income. In Novo Remanso, due to the use of technologies (staggered planting, floral induction, among others), it is produced all year round. However, there is no demand for commercialization in the Manaus market, leading to wasted production or sale at low prices, a reality also found by Maia & Oliveira (2018), on the pineapple production chain in Novo Remanso.

Financing could reduce problems related to marketing; however, producers reported difficulties in obtaining financing, mostly due to the bureaucracy required. Some producers supply their products to the PNAE (National School Feeding Program); however, the amount paid of R$ 1.30/ fruit in 2021 did not cover the cost of production. In addition, some public notices issued by the state government for the purchase of family farming products require the producer to be a client of certain financing banks indicated by the government, thus restricting access to credit.

Mean and overall indices observed in technologies

In general, technology level B predominated among producers (Figure 04), meaning that they employ more than 50% of the recommended technologies in pineapple cultivation, directly influencing the general technological index (GI) found, which was 0.59, as shown in Figure 05. This scenario is different from the results of Souza et al. (2019), who found that the Northern and Northeastern regions have a low or very low rate of use of recommended technologies.

Among the technologies studied, the ones that are least used by producers refer to seedling selection and harvest/post-harvest technologies, which presented level C, i.e., for these technologies, less than 50% of the recommended technologies are used. The adoption of certified seedlings, care in storage, proper transportation of post-harvest fruits, and processing capacity are factors that could increase production and marketing (Sampaio & Fredo, 2021). The technologies of machinery, equipment, and tools, as well as fertilization, planting, and cultivation treatments, were level C (Figure 2).

Regarding the contribution of each technology in the general technological index, Figure 5 indicates that the cultivation treatments presented technological index that contributed most in the composition of the GI, followed by the technologies of machinery, equipment, and tools; fertilization; planting; and harvest/post-harvest. The seedling selection technology contributed the least to the overall composition of the technological level of pineapple producers, which confirms the low adherence of producers to these last two technologies.

5. Conclusions

Producers in Novo Remanso generally presented technology level B, i.e., they use 50% of the recommended technologies. The individual observation of the producers showed that the technology adopted is not considered optimal, nor insufficient, for any of them. They all produce pineapple at an intermediate technological level, i.e., B level of technology.

The insufficient adoption of harvest/post-harvest and seedling selection technologies by all producers surveyed shows that Novo Remanso needs to improve these organizational aspects of production.

Despite being classified as family farmers, they are market-oriented in their use of technology. This scenario leads the agriculture practiced in the area to be directed toward agribusiness, transforming the techniques used with moderately technified production. This technological level has encouraged the implementation of pineapple monoculture.

If, on the one hand, these technologies have enabled greater economic gains, with an average income of two minimum wages, on the other hand, producers are at a disadvantage to serve the market due to the lack of adequate infrastructure for the commercialization of the product.

The addition of technology needs to be followed by research and government incentives related to the development of strategies that ensure that pineapple reaches new market niches, mainly considering the high perishability of the fruit, which leads to losses in storage and transportation. Conservation practices must also be introduced in the area, such as the intercropping of species and the greater use of property resources, enabling greater diversity of income sources and reducing production costs.

The results for the general technological index (GI) of 0.59 also reveal a tendency of producers to adopt recommended technologies inappropriately, failing to consider environmental aspects. The mean technological index (IT_m) observed for the use of chemical fertilization and pesticides in the control of weeds and pests presents a threat to the sustainability of production, especially since it is family farming developed in the Amazon, which must consider the use of technologies combined with the conservation of natural resources (soil, water, air) that sustain food production in the region.

The actions of COOPANORE, which was more efficient before the COVID-19 pandemic, should be reactivated to facilitate the commercialization of pineapple production, given its potential to mediate marketing improvements in Novo Remanso and improve the structure of this production chain for the state of Amazonas.

The study also points out the need to implement public policies to lower production costs and increase the amount paid on the market, both on the free market and by the PNAE, to provide a fairer profit margin for farmers. Added value through fruit processing and diversification of pineapple products also needs to occur by installing or reactivating agro-industry in the area. These measures will avoid or at least minimize production losses and reduce the large profits received by the middleman to the detriment of the producer.

Reducing the bureaucracy required by the financing banks in granting credits and the adequacy of transportation/storage could enhance the growth of pineapple production in Novo Remanso. The results of this elucidate needs and proposals for management and research institutions to step up to the challenge of developing technologies to reflect the desires and knowledge of producers for more sustainable pineapple production, considering the unique geographical, edaphoclimatic, institutional, cultural, social, and economic aspects of the Amazon region.

6. Acknowledgement

The Pro-Rector of Research and Postgraduate Studies – PROPESP, at the Federal University of Amazonas – UFAM. To the postgraduate program in science and technology for Amazonian resources – PPGTRA. The Coordination for the Improvement of Higher Education Personnel – CAPES. The Amazonas State Research Support Foundation – FAPEAM.

7. References

Abiko, A. K. (2003). Tecnologia apropriadas a construção civil. In: *Tecnologia e materiais alternativos de construção.* Campinas: Editora da UNICAMP. Recuperado em 25 de novembro de 2022, de http://www.lemcc.com.br/wp-content/uploads/sites/64431/2016/08/MCC-Aula-02 Tecnologia-Apropriada.pdf

Alfaia, M. C. (2019). *A impressão da paisagem pelo uso e ocupação da terra no entorno da vila de Novo Remanso em Itacoatiara/AM* (Dissertação de mestrado). Instituto de Filosofia, Ciências Humanas e Sociais, Universidade Federal do Amazonas, Manaus.

Alves, T. J. C., Noda, S. N., & Noda, H. (2018). A família nos agroecossistemas Amazônicos: o caso do Complexo Ambiental Sacaí, Baixo rio Branco, Roraima, Brasil. *Revista de Economia e Sociologia Rural*, *56*(3), e501516. http://dx.doi.org/10.1590/1234-56781806-94790560309

Andrade, H. (2012). *Desenvolvimento rural sustentável: uma visão territorial*. Angola: FAO.

Araújo, J. R. G., Turetta, A. P. D., Andrade, A. G., Pimentel, J. C. M., & Andrade, F. G. (2012). Abacaxi 'turiaçu': cultivar tradicional Nativa do Maranhão. *Revista Brasileira de Fruticultura*, *34*(4), 1270-1276.

Balsadi, O. V., Borin, M. R., Silva, J. G., & Belik, W. (2002). Transformações tecnológicas e a força do trabalho na agricultura brasileira no período de 1960-2000. *Caderno de Agricultura*, *49*, 23-40. Recuperado em 5 de julho de 2022, de http://www.iea.sp.gov.br/out/LerTexto.php?codTexto=396

Barbosa, W. F., & Souza, E. P. (2013). Nível tecnológico e seus determinantes na apicultura cearense. *Revista de Política Agrícola*, *3*(3), 32-41.

Brasil. (2006). Lei n° 11.326 de 24 de julho de 2006. Estabelece as diretrizes para a formulação da Política Nacional da Agricultura Familiar e Empreendimentos Familiares Rurais. *Diário Oficial [da] República Federativa do Brasil*, Brasília. Recuperado em 5 de julho de 2022, de http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/lei/l11326.htm

Brasil. (2013, August 6). Lei n° 12.852 de 05 de agosto de 2013. Institui o Estatuto da Juventude e dispõe sobre os direitos dos jovens, os princípios e diretrizes das políticas públicas de juventude e o Sistema Nacional de Juventude - SINAJUVE. Recuperado em 9 de setembro de 2023, de https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2013/lei/l12852.htm

Brasil. (2016). Resolução nº 510, de 7 de abril de 2016. Dispõe sobre as normas aplicáveis a pesquisas em Ciências Humanas e Sociais cujos procedimentos metodológicos envolvam a utilização de dados diretamente obtidos com os participantes. *Diário Oficial [da] República Federativa do Brasil*, Brasília. Recuperado em 5 de julho de 2022, de https://conselho.saude.gov.br/resolucoes/2016/Reso510.pdf

Callegari-Jacques, S. M. (2003). *Bioestatística princípios e aplicações*. Porto Alegre: Artmed.

Carvalho, R. A., & Lacerda, J. T. (2005). Controle da podridão negra do abacaxi com conservantes alimentares. In *Anais do Simpósio Brasileiro de Pós-colheita de Frutos Tropicais.* João Pessoa: SBPCFT.

Confederação Nacional da Agricultura – CNA. (1999). *Um perfil do agricultor brasileiro: suas principais tendências e implicações para o treinamento dos pequenos proprietários e trabalhadores rurais* (50 p., Estudos Gleba, nº 9). Brasília: CNA.

Cruz, N. B., Jesus, J. G., Bacha, C. J. C., & Costa, E. M. (2020). Acesso da agricultura familiar ao crédito e à assistência técnica no Brasil. *Revista de Economia e Sociologia Rural*, *59*(3), e226850. http://dx.doi.org/10.1590/1806-9479.2021.226850

Dickel, S. L., & Zanella, A. (2020). História do mundo rural: o sul do Brasil. In A. Zanella (Ed.), *Envelhecimento e Sucessão rural: dois desafios para a Agricultura Familiar na região da AMAU (2006-2017)* (Vol. III, p. 247). Passo Fundo: Acervo Editora.

Fraxe, T. J. P., Pereira, H. S., & Witkoski, A. C. (2007). A agricultura familiar: principal fonte de desenvolvimento socioeconômico e cultural das comunidades da área focal do projeto PIATAM. In *Comunidades ribeirinhas amazônicas modos de vida e uso dos recursos naturais*. Manaus: Editora EDUA.

Freitas, D. G. F., Khan, A. S., & Silva, L. M. R. (2004). Nível tecnológico de produção de mel (*Apis melífera*) no Ceará. *Revista de Economia e Sociologia Rural*, *42*(1), 171-188.

Garcia, M. V. B., Garcia, B., Matos, A. P., Junghans, D. T., & Cabral, R. S. (2013). *Situação e perspectivas da abacaxicultura no Amazonas.* Recuperado em 5 de julho de 2022, de https://www.researchgate.net/publication/274064690_SITUACAO_E_PERSPECTIVAS_DA_ABACAXICULTURA_NO_AMAZONAS

Gomes, A. L. S., & Nogueira, E. M. L. (2022). Educação do Campo no contexto amazônico: uma análise sobre os desafios e possibilidades como política educacional. *Conjecturas*, *22*(10), 298-311. http://dx.doi.org/10.53660/CONJ-1580-EDU23

Gomes, J. A., Ventura, J. A., Alves, F. L., Arleu, R. J., Rocha, M. A. M., & Salgado, J. S. (2003). *Recomendações técnicas para a cultura do abacaxizeiro*. Vitória: INCAPER.

Gomes, M., & Walter, A. (2023). Impactos de mudanças tecnológicas e organizacionais nas condições de trabalho no setor canavieiro brasileiro: uma análise de 2000 a 2019. *Revista de Economia e Sociologia Rural*, *61*(2), e257923. http://dx.doi.org/10.1590/1806-9479.2021.257923pt

Gonçalves, M. F. (2011). *Agricultores familiares produtores de mamona no Ceará: nível tecnológico e seus determinantes* (Dissertação de mestrado). Universidade Federal do Ceará, Fortaleza.

Instituto Brasileiro de Geografia e Estatística – IBGE. (2017). *Censo agropecuário 2017: resultados definitivos*. Recuperado em 5 de outubro de 2022, de https://sidra.ibge.gov.br/pesquisa/censo-agropecuario/censo-agropecuario-2017

Instituto Brasileiro de Geografia e Estatística – IBGE. (2021). *Em 2021, rendimento domiciliar per capita cai ao menor nível desde 2012.* Recuperado em 5 de outubro de 2022, de https://agenciadenoticias.ibge.gov.br/agencia-noticias/2012-agencia-de noticias/noticias/34052-em-2021-rendimento-domiciliar-per-capita-cai-ao-menor-nivel-desde-2012

Instituto de Desenvolvimento Agropecuário e Florestal Sustentável do Amazonas – IDAM. (2012). *Relatório de atividades.* Recuperado em 5 de outubro de 2022, de www.idam.am.gov.br/wp-content/uploads/2014/01/RAIDAM2012.pdf

Instituto de Desenvolvimento Agropecuário e Florestal Sustentável do Amazonas – IDAM. (2019). *Relatório atividades trimestral*. Recuperado em 5 de outubro de 2022, de http://www.idam.am.gov.br/biblioteca/biblioteca-rat/

Instituto de Desenvolvimento Agropecuário e Florestal Sustentável do Amazonas – IDAM. (2020). *Abacaxi da região de Novo Remanso é destaque como patrimônio imaterial do Amazonas.* Recuperado em 5 de outubro de 2022, de www.idam.am.gov.br/abacaxi-da-regiao-de-novo-remanso-e-destaque-como-patrimonio-imaterial-do-amazonas/

Instituto Nacional de Colonização e Reforma Agrária – INCRA. (2020a). *Módulo fiscal.* Recuperado em 9 de maio de 2023, de https://www.gov.br/incra/pt-br/assuntos/governanca-fundiaria/modulo-fiscal

Instituto Nacional de Colonização e Reforma Agrária – INCRA. (2020b). *Consultar índices básicos.* Recuperado em 9 de maio de 2023, de https://pro-pgt-incra.estaleiro.serpro.gov.br/pgt/indices-basicos

Lima, J. R. T. (2021). Mecanização agrícola, trabalho e subjetividade: a Teoria das Representações Sociais como recurso para compreensão das mudanças ocorridas nos canaviais brasileiros. *Revista Colombiana de Sociologia*, *4*(1), 73-96.

Maia, B. J., & Oliveira, F. L. (2018). A cadeia produtiva do abacaxi no Novo Remanso: como está seu desenvolvimento? In *Anais do Seminário Internacional de Ciências do Ambiente e Sustentabilidade na Amazônia.* Manaus: UFAM. Recuperado em 9 de maio de 2023, de https://www.even3.com.br/anais/5sicasa/93197-acadeia

Marconi, M. A., & Lakatos, E. M. (2007). *Técnicas de pesquisa* (6ª ed.). São Paulo: Atlas.

Matos, A. P., Reinhardt, D. H., Sanches, N. F., Souza, L. F. S., Elias Junior, J., & Gomes, D. C. (2009). *Produção de mudas sadias de abacaxi* (Circular Técnica, No. 89). Embrapa. Recuperado em 9 de maio de 2023, de ainfo.cnptia.embrapa.br

Matos, F. F., Martins, P. F. S., & Silva, L. M. S. (2019). Receptividade de técnicas de cultivo sem queima em sistema de produção familiar na Amazônia oriental. *Revista Brasileira de Agroecologia*, *14*(1), 33-39. http://dx.doi.org/10.33240/rba.v14i1.22904.

Matos, V. D. (2005). *A apicultura no estado do Ceará: produção, exportação, nível tecnológico, fatores condicionantes, competitividade dos produtores* (Dissertação de mestrado). Universidade Federal do Ceará, Fortaleza.

Meneghetti, G. A., & Souza, S. R. (2015). A agricultura familiar do Amazonas: conceitos, caracterização e desenvolvimento. *Revista Terceira Margem Amazônia*, *1*(5), 36-57.

Miranda, E. A. A. (2001). *Inovações tecnológicas na viticultura do sub-médio São Francisco* (Tese de doutorado). Universidade Federal de Pernambuco, Recife.

Moreira, J. C., & Sene, E. (2016). *Geografia geral e do Brasil. Unidade 5: o espaço rural e a produção agropecuária* (3ª ed., cap. 11, p. 257). São Paulo.

Nascimento, C. A., Aquino, J. R., & Delgrossi, M. E. (2022). Tendências recentes da agricultura familiar no Brasil e o paradoxo da pluriatividade. *Revista de Economia e Sociologia Rural*, *60*(3), e240128. http://dx.doi.org/10.1590/1806-9479.2021.240128

Noda, S. N., Noda, H., & Silva, I. C. (2013). Socioeconomia das unidades de agricultura familiar no Alto Solimões: formas de produção e governança ambiental. In H. Noda, P. Léna, A. E. Laques & S. N. Noda (Eds.), *Dinâmicas socioambientais na agricultura familiar na Amazônia* (pp. 51-72). Wega.

Oliveira Neto, A.A. (2020). *A participação do abacaxi no desenvolvimento econômico das regiões produtoras* (Compêndio de Estudos Conab, No. 24). Brasília: Conab.

Oliveira, M. A. S. (2003). *Nível tecnológico e seus fatores condicionantes na bananicultura do município de Mauriti-CE* (Dissertação de mestrado). Universidade Federal do Ceará, Fortaleza.

Oliveira, M. F., Mendes, L., & van Herk Vasconcelos, A. C. (2021). Desafios à permanência do jovem no meio rural: um estudo de casos em Piracicaba-SP e Uberlândia-MG. *Revista de Economia e Sociologia Rural*, *59*(2), e222727. http://dx.doi.org/10.1590/1806-9479.2021.222727

Paiva, D. M., Alves, C. R. & Gomes, S. P. (2019). A agricultura familiar como alternativa sustentável: para um aprimoramento conceitual. *Revista Gestão em Foco*, *11*, 1-14.

Pereira, C. N., & Castro, C. N. (2021). *Agricultura familiar, assistência técnica e extensão rural e a política nacional de Ater*. Brasília: IPEA. Texto para Discussão, nº 2704.

Queiroz, J. P. (2013). *Produção de mudas de abacaxizeiro Turiaçu (Ananas comosus (L.) Merrill), em Manaus-AM pela técnica de secionamento do caule e desenvolvimento de plântulas em tubete e canteiro* (Dissertação de mestrado). Faculdade de Ciências Agrárias, Universidade Federal do Amazonas, Manaus.

Reinhardt, D. H., & Souza, L. F. S. & Cabral, J. R. S. (Ed.). (2000). *Abacaxi- produção: aspectos técnicos.* Brasília: Embrapa Comunicação para Transferência de Tecnologia.

Sampaio, R. M., & Fredo, C. E. (2021). Características socioeconômicas e tecnologias na agricultura: um estudo da produção paulista de amendoim a partir do Levantamento das Unidades de Produção Agropecuária (LUPA) 2016/17. *Revista de Economia e Sociologia Rural*, *59*(4), 236538. http://dx.doi.org/10.1590/1806-9479.2021.236538

Santos, C. (2012). *Níveis tecnológicos de agroecossistemas do milho no estado de Sergipe* (Dissertação de mestrado). Universidade Federal de Sergipe.

Silva, L. J. S., Meneghetti, G. A., Pinheiro, J. O. C., Guimarães, R. R., & Lourenço, J. N. P. (2013). Reflexões sobre agricultura familiar, inovação e desenvolvimento na Amazônia. In *Anais do 51° Congresso da Sociedade Brasileira Economia, Administração e Sociologia rural SOBER.* Belém.

Silva, S. E. L., Souza, A. G. C., Berni, R. F., & Souza, M. G. (2004). *A cultura do abacaxizeiro no Amazonas* (Circular Técnica, No. 21). Recuperado em 21 de novembro de 2020, de ainfo.cnptia.embrapa.br

Souza, P. M., Fornazier, A., Souza, H. M., & Ponciano, N. J. (2019). Diferenças regionais de tecnologia na agricultura familiar no Brasil. *Revista de Economia e Sociologia Rural*, *57*(4), 594617. http://dx.doi.org/10.1590/1806-9479.2019.169354

Teixeira, C. A. D., Rosa Neto, C., Leôndidas, F. C., Costa, J. N. M., Vieira Júnior, J. R., Silva, F. A. C., & Wadt, P. G. O. (2020). *Sistema de produção para a cultura do abacaxi no Estado de Rondônia*. Porto Velho: Embrapa Rondônia.

Wolf, E. (1970). *Sociedades camponesas*. Rio de Janeiro: Zahar.

Zago, N. (2016). Migração rural-urbana, juventude e ensino superior. *Revista Brasileira de Educação*, *21*(64), 61-78.

Submitted on: November 25, 2022.
Accepted on: June 19, 2023.
JEL Classification: Q16, O33.