

NEW FAMILY FARMERS IN BAHIA, BRAZIL: ANALYSIS OF THE KEY FACTORS INFLUENCING CROP CHOICE

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Abstract:

Family farming plays a pivotal role in shaping rural livelihoods and landscapes. Understanding the dynamics behind crop selection by family farmers reveals critical intersections between economic priorities, environmental sustainability, and food security. This study examined the main crops chosen by family farmers in a rural area in Southern Bahia, Brazil, and the key factors influencing this choice. The preferred crops were cassava, banana, passion fruit, corn, cacao, black pepper, and coffee. Among these seven crops, three are commodities: cacao, black pepper, and coffee. We analyzed the main crops according to their regional specificities of cultivation, market, labor conditions, and management strategies. This study points to the high relevance of economic factors in the choice of crops, indicated by the preference for commodities and cash crops, and almost no crops for self-consumption. We also discussed how these choices affect the environment, by putting pressure on preservation areas and using agrochemicals without control. The analysis shows an imbalance in the key crop choice factors and the farming systems chosen by farmers who are currently food insecure.

Keywords: family farming, commodities, food security, *Manihot esculenta*, *Theobroma cacao*.

1. Introduction

Southern Bahia is the site of historical and current land disputes among indigenous peoples, social movements fighting for land, *quilombolas*, and eucalyptus forestry companies (Silva, 2003; Ferreira *et al.*, 2019; Trevizan, 2019; Rabbani *et al.*, 2020). Also, this region is a hotspot within the Atlantic Forest due to its high biodiversity and the incidence of endemic and threatened species (Myers *et al.*, 2000; Martini *et al.*, 2007), being a critical area for biodiversity conservation (Ostroski *et al.*, 2018).

In the last decade, landless movements have gotten stronger and occupied 30 areas owned by forestry companies in the region (Rabbani *et al.*, 2020). The area occupied by

the association described in this paper belonged to Veracel Celulose S.A., which owns 200,814 ha of land in 11 municipalities in this region. Between 2009 and 2016, Veracel Celulose S.A. filed several lawsuits in the Bahia State Court to recover these properties. The lawsuits were filed against family farmer associations. As the legal owner of these properties, the company signed court orders in 2018 under which it committed to enter into a partial and individual agreement for the purchase and sale of these areas, transforming the illegal occupations into land properties. In this way, farmers bought the land under an agreement regime that avoided an expensive and time-consuming litigation process (Rabbani *et al.*, 2020). Farmers got a 3-year grace period from the

date the contract was signed with the company to begin the yearly payment of their plots installments. In total, there will be 17 of them. This study aims to document the main crops currently cultivated and those desired by farmers, to identify the key factors influencing their crop choices and to evaluate the viability of the selected crops.

Traditional farmers have domesticated, improved, and conserved thousands of crop species and varieties (Mastretta-Yanes, 2024; Fuller *et al.*, 2023; Levis *et al.*, 2024). However, throughout history, and especially in recent decades, biodiversity loss and crop homogenization have brought significant risk to the world food supply (Altieri, 1999; Heal *et al.*, 2004; Mustafa, 2021). The loss of biodiversity also applies to agriculture. Many plant and animal species that have historically been sources of food are being consumed less and less, with food monoculture production being the primary cause of global biodiversity loss (Benton *et al.*, 2021). For smallholder farming households, a common change is from subsistence-oriented crop production to a

commercially oriented one (Manlosa, 2019). Genetic diversity is intrinsic to increasing agricultural productivity, resistance to pests and pathogens, and resilience to extreme weather and climate change, as well as to ensuring food and nutrition security (Heal *et al.*, 2004; Mustafa, 2019; Benton *et al.*, 2021). Understanding how farmers choose their crops is essential to maintaining biodiversity, managing agricultural, environmental, and social risks, and proposing good agroecological models. Crop choice is motivated by a network of information and relationships, and this study aims to investigate this in the context of the new farm families, the ones that recently settled in the invaded and negotiated land.

2. Methodology

2.1 Study area – Nova Vitória Association

The Nova Vitória Association was founded in 2015, following the occupation of 305.4 hectares of the Veracel-owned Mutum Farm at the end of 2011, in the municipality of Eunápolis, southern Bahia (Figure 1). Currently, the association comprises 64 families, approximately 220 people. The land is divided into plots of about 5 hectares each, comprising agricultural land and preservation areas. From the total 306 hectares, about 159 hectares are arable land, 29 hectares are permanent preservation areas, and 118 hectares are Legal Reserves. The residents are people who have lived in rural areas and nearby urban areas. The racial composition of the farmers is 73% black or mixed, 22%

46 NEW FAMILY FARMERS IN BAHIA, BRAZIL: ANALYSIS OF THE KEY FACTORS INFLUENCING CROP CHOICE

white, 3% indigenous, and 1% Asian (Narezi *et al.*, 2020). Regarding food security indices (EBIA), 16% of the population is severely food insecure, 23% is moderately food insecure, 48% is mildly food insecure, and only 14% is considered to have food security, meaning that 86% of the population is food insecure to some degree. In addition, 48% earn less than one minimum wage, or less than \$195.00 per month, and none has access to electricity (Narezi *et al.*, 2020). Farmers do not have access to credit lines at banks because it would be necessary to register their property with the competent environmental agency (CEFIR), which, in the case of this association, is a collective.

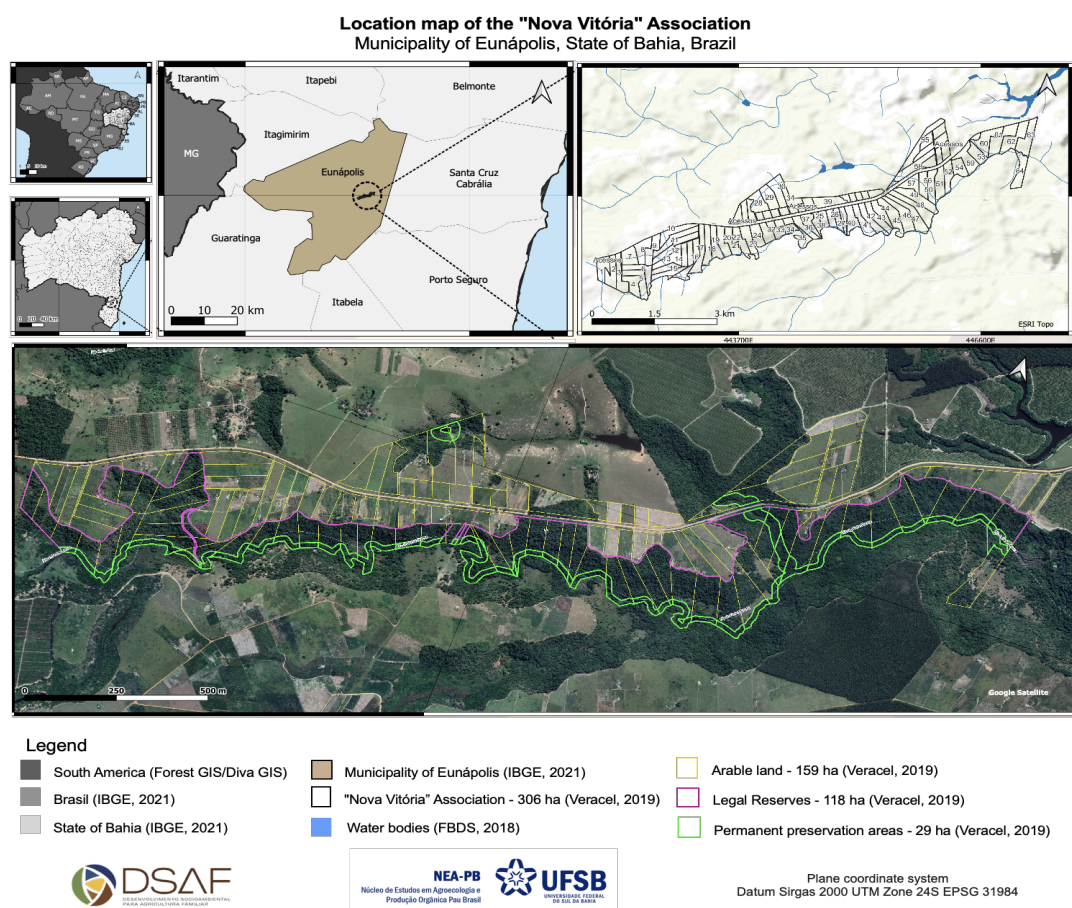


Figure 1. Location map of the "Nova Vitória" Association in Eunápolis, Bahia, and the division of the plots. Source: *Desenvolvimento Socioambiental para Agricultura Familiar* – DSAF Database.

2.2 Data collection procedures

The initial methodology was participant observation (Robson; McCartan, 2016a), over three years, in the Nova Vitória Association. Subsequently, a questionnaire (Robson; McCartan, 2016b) was applied to the farmers with questions about the main existing and desired crops in their plots¹. Finally, a ranking of the key factors that influence this choice

¹ The questionnaire was approved by the board of directors of the Nova Vitória Association and by the Human Research Ethics Committee with registration number 70617123.9.0000.8467. All interviewees signed the Free and Informed Consent Form.

47 NEW FAMILY FARMERS IN BAHIA, BRAZIL: ANALYSIS OF THE KEY FACTORS INFLUENCING CROP CHOICE

was created. The key factors used as reference were those proposed in the work of Greig (2009), who suggested that a farmer's choice of crops is based on five main factors. The key factors proposed by Greig (2009) were translated into Portuguese and discussed in community meetings between farmers and researchers (before the Covid-19 pandemic), and were considered by both groups to be comprehensive. These crop choice factors are responsible for the differences in production from one region to another around the world (Liliane; Charles, 2020).

Some modifications were made to Greig's (2009) methodology, which took into consideration a scale from 1 to 5 for each crop, with "1" being *very unimportant* and "5" being *very important*. For this study, the farmers were asked to choose the three most important factors for each chosen crop. This modification facilitated the application of the questionnaire when the researcher could not be present during the period of isolation due to the Covid-19 pandemic.

Data were collected from March to June 2021, through semi-structured questionnaires, printed on A4 paper sheets, handed out to the farmers. The survey asked questions about age, gender, plot number, and then about agricultural production. Regarding agricultural production, farmers listed their three main existing crops and the factors that influenced the selection of these crops, from a predetermined list, adapted from Greig (2009). They were then asked about their three main desired crops and the factors influencing this choice. Twenty-one factors that influence the choice of crops were presented beforehand. There was also room to list other factors outside this list. The 21 factors were divided into five categories: physical, economic, personal, productive, and available resources (Greig, 2009). Due to social isolation because of the Covid-19 pandemic, a video was recorded to explain the purpose of the research, its ethical aspects – including the free and informed participation –, and a step-by-step guide on how to fill out the questionnaire. This was then sent to the members of the Nova Vitória Association through the WhatsApp group composed of both farmers and researchers. The president of the association was responsible for receiving the questionnaires and forwarding them to the researchers. Sixty-four questionnaires were sent out. The results of the questionnaire were discussed and validated with the members of the association, and this article is co-authored by the president of the Nova Vitória Association, a farmer with 25 years of observational participation in these areas.

2.3 Data analysis

The principal existing and desired crops were ranked according to the number of times they were cited by farmers, in descending order from the highest to the lowest number of citations. Concurrently, each of the 21 factors that influenced the choice of crops were also ranked by the number of citations, along with the categories to which they belong (Table 1). The results of the analysis of the top three existing and desired crops were cross-checked with the results of the influencing factors. The crops mentioned as most

important were then analyzed according to their regional specificities of cultivation, market, labor conditions, and management strategies.

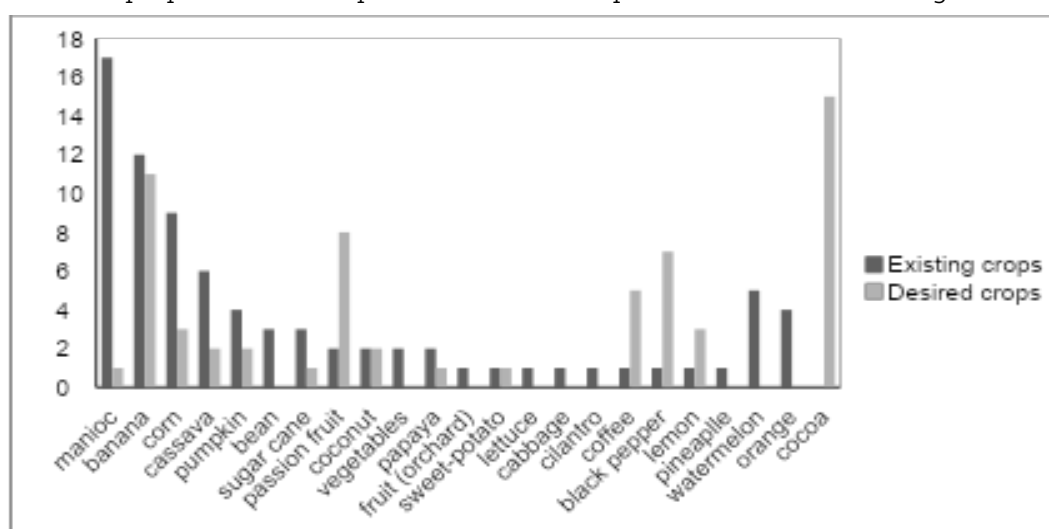
3. Results and Discussion

Sixty-four questionnaires were sent to the Nova Vitória Association. Among the respondents, 59.3% were women and 40.7% were men. The average age was 41 years old.

3.1 Most frequently mentioned crops

3.1.1 *Existing crops*

The most important existing crops in the community are shown in Figure 2. Regarding crop species and varieties, farmers chose crops based on commercial criteria. Twenty crops were mentioned. Cassava represented 23.9% of the total; banana was mentioned by 16.9%; and corn was cited by 12.7% of the farmers. They were considered the most important crops, followed by manioc, pumpkin, beans, and sugar cane, which together totaled 22.5%. It is important to note that land issues had until then, influenced the choice of existing crops: without land tenure, farmers would not invest in perennial crops, which are usually more expensive. This could explain why some of the desired crops are cacao, coffee, black pepper, and passion fruit, which are perennial crops that may require investments in the medium and long-term. This trend was also observed by Barbier (1997) and Dercon and Ayalew (2007), who point out that there is a strong correlation between land tenure rights and land allocated for perennial crops. Although the security of land tenure can be a crucial factor in land use decisions, some landowners without land tenure do adopt perennial crops in order to acquire basic land use rights and



subsequent legal registration rights (Wannasai; Shrestha, 2008).

Figure 2. Levels of importance, by citation, of existing and desired crops in the Nova Vitória Association in Eunápolis, Bahia. Source: field activities, 2019.

3.1.2 *Desired crops*

The most desired crops by the community are presented in Figure 2. A total of 18 crops were mentioned. Among these, cacao (20.5%), banana (15.0%), and passion fruit (10.9%) were considered the most desired crops, followed by black pepper (9.5%), coffee (6.84%), watermelon, orange, lemon, and corn, which together added up to 20.5% of the citations.

The entire area of the Nova Vitória Association was previously planted with eucalyptus. Although the area cultivated for food production is still small and the diversity of crops is still low, this represents a conversion of land use from a

monoculture of eucalyptus to food production, which increased the diversity of species cultivated. This phenomenon can be considered contrary to history the majority of territories in Brazil and the world, where the expansion of eucalyptus forestry, together with transformations in the workforce and land use and occupation, contribute to the restructuring and, consequently, the productive specialization of the territories which were mostly directed towards family-based agriculture and small animal husbandry (Kerbo *et al.*, 2024; Tesfaw *et al.*, 2023; Bayle, 2019). The expansion of eucalyptus monoculture decreases productive diversity and food production, leading to the expropriation of peasant farmers and the transformation of labor relations (Ezquinaze; Souza, 2013; Zerga *et al.*, 2021; Oliveira *et al.*, 2022).

3.2 Crop selection factors

The selection factors for crops are presented in Table 1.

Table 1. Main factors influencing the choice of crops for the settlers of the Nova Vitória Association in Eunápolis, Bahia (2021). Source: adapted from Greig (2009).

PHYSICAL FACTORS			
	no. of citations	% / total	% / factor
Soil quality	21	7.9	37.5
Availability of water	15	5.7	26.7
Terrain	9	3.4	16
Climate	12	4.5	21.4
Subtotal	57	21.2	100
ECONOMIC FACTORS			
Ease of sale	51	19.3	50.4

50 NEW FAMILY FARMERS IN BAHIA, BRAZIL: ANALYSIS OF THE KEY FACTORS INFLUENCING CROP CHOICE

Crop price	31	11.7	30.6
Seed price	4	1.5	3.9
Available labor	11	4.1	10.8
Available financing	4	1.5	3.9
Subtotal	101	38.4	100
PERSONAL FACTORS			
Cultivation leaves considerable free time	15	5.7	20.8
Easy to plant and harvest	16	6	22.2
Experience in growing crops	17	6.4	23.6
Other people influenced this decision	4	1.5	5.5
Enjoys this type of production	20	7.6	27.7
Subtotal	72	27.3	100
PRODUCTION FACTORS			
Harvest yield	16	6	64
Growing time	1	0.3	4
Resistance to pests	8	3	32
Subtotal	25	9.5	100
AVAILABLE RESOURCES			
Availability of fertilizer	2	0.7	25
Availability of machinery	2	0.7	25
Availability of pesticides	3	1.1	37.5
The researcher suggested the crop	1	0.3	12.5
Subtotal	8	3	100
Total	262	100	

Figure 3 was created by adding up the value of all mentioned crops in each category. The preponderance of economic, personal, and physical factors in the choice of crops can be observed, with production factors and available resources rarely being considered. In Malawi, economic (marketing) and personal (less labor) factors were also noted as being prevalent in the choices of cassava cultivation systems (Ortega *et al.*, 2016). The disparity of factors that influence choice by the Nova Vitória farmers is notable (Figure 3), and these figures corroborate participant observation in the area. Economic factors are paramount in the choice of crops, with available resources and production factors being the least cited. Each one is discussed separately below.

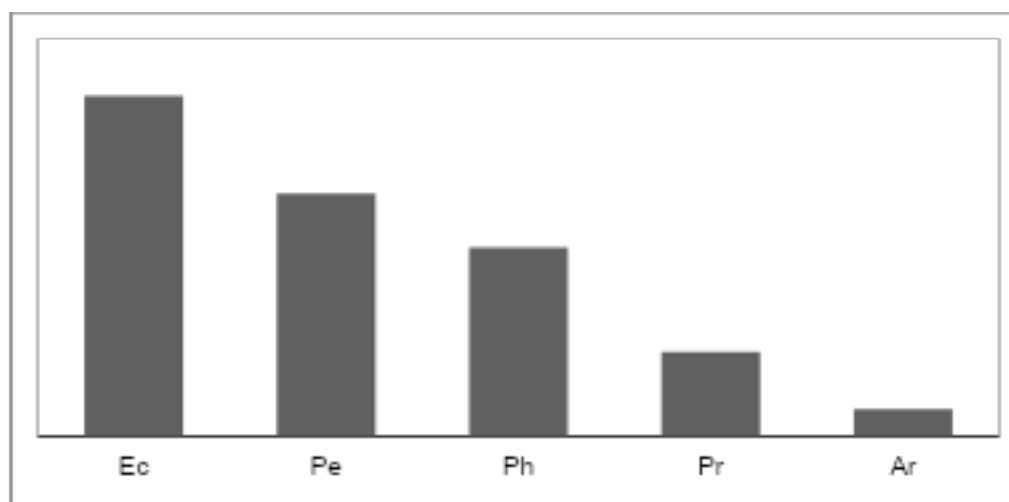


Figure 3. Levels of importance of the factors influencing choice of crops in the Nova Vitória Association. Ec-economic. Pe-personal. Ph-physical. Pr-production. Ar-available resources.

3.2.1 *Economic factors*

Economic and market factors were cited as the most important factors in choosing which crop to plant. Among the economic factors, marketability was the most frequently cited (50.4%), followed by the yield price (30.6%). These two factors are the most relevant in the overall score as well, therefore being the main factors underpinning the choice of crops. As contextualized earlier, these farmers will soon have to begin paying for the plot, which increases pressure on these families to generate income, leading to the choice of crops with high economic value. For farmers in small areas, who have little investment and financing capacity, it is important to think about crop diversification and staggered production, due to the difficulty in managing the risks of small-scale monoculture. Farmers who choose production based on risk versus income do not take into account the need for a pattern of diversity, and when they do not have financial reserves, they are subject to starvation if they lose their crops (Heal *et al.*, 2004).

Associates are not considered traditional farmers, with crops, knowledge, and practices guided by traditional identity. However, they have some connection with the land and some agricultural knowledge. They are on the land to generate income, but the lack of financial education to understand the risks of only perceiving crops economically is an aggravating factor. Production that targets just economic and market factors in poor settlements can be a problem not only in managing production risks (Howden *et al.*, 2007; Rivera-Padilla, 2020), but also regarding food security. Studies in Brazilian rural

settlements have linked the high rate of food insecurity among settlers to low agricultural diversity and food monotony (Dombek, 2006; Busato, 2011; Almeida *et al.*, 2017; Graciano *et al.*, 2018; Trivellato *et al.*, 2019). In Mexico, on the other hand, farmers chose subsistence crops over market-oriented crops (Rivera-Padilla, 2020) due to their subsistence needs and the high trade costs of commercial crops. Households that farm for self-consumption, in addition to commercial production, have higher levels of food security (Manlosa, 2019).

3.2.2 *Personal factors*

After economic factors, personal factors were the most frequently cited. This result contrasts with that of Greig (2009), who found that personal factors were considered unimportant for farmers in Tanzania. The top four personal factors cited were: enjoying this type of production (27.7%), followed by having experience in growing the crop (23.6%), being easy to plant and harvest (22.2%), and planting practice leaving enough free time (20.8%). The regional history of cacao, banana, and cassava production by the population of the region explain the first two factors, as it will be shown below in the section on crops. The two subsequent factors are explained by the fact that many producers have other jobs besides cultivating the plot, which is often their family's main source of income, meaning that a low demand for time and labor facilitates pluriactivity. These other jobs, called accessory jobs in Brazil, happen when the farmer partially becomes a temporary wage worker, characterized as an important source of income for the family farming unit (Silva, 2019). In the Nova Vitória Association, the forms of accessory work are temporary wage labor in larger properties (mainly for the coffee harvest), and the occupation of family members in rural industries (cellulose and poultry), as a parallel form of earning income, which aligns perfectly with the types of accessory occupation in small farms described by Kautsky (1980). This leads to the discussion of two important points regarding the choice of crops: 1) change of crop patterns and adoption of new technologies; and 2) income obtained from the farm. In Brazil, in addition to regional differences, there are inequalities between the segments of agriculture (family farming and corporate farming) and specific crops (some having a commodity profile and others associated more with the domestic market) within the same region (Filho *et al.*, 2011). Personality traits, such as risk aversion, discipline, ambition of the farmer, access to knowledge, credit, and rural extension services are determining factors for the choice and adoption of technology (Alves *et al.*, 2013), and today one of the most important factors is rural digital inclusion (Buainain *et al.*, 2021). In Indonesia, Klasen *et al.* (2014) showed how the shift from coffee to cacao plantations was a crucial strategy to increase the income of the poorest rural populations, and that innovation and experimentation with new crops were responsible for increasing regional agricultural production yields, not just deforestation, world commodity price increases, and production efficiency. Nevertheless, the difficulty farmers have in adopting technological innovations is a worldwide problem, as is the importance of finding effective methods to address it (Alizadeh *et al.*, 2022; Caffaro *et al.*, 2020; Munguia; Llewellyn, 2020; Blazy *et al.*, 2011).

The role of off-farm income has been well discussed around the world, and in developing countries, the off-farm income of rural farmers has been increasing. In Mexico, currently 80% of rural household income come from non-farm sources, a significant increase from

the 55% in 1997 (Janvry; Sadoulet, 2001; Pfeiffer *et al.*, 2009). In Nigeria, non-farm sources accounted for 90% of income (Babatunde; Qaim, 2009). According to Pfeiffer *et al.* (2009), non-farm income in Mexico has a negative effect on agricultural production and the use of family labor in the farm, but has a positive impact on the demand for purchased supplies. In the USA, farmers in smaller farm units improve their economic performance by compensating for scale disadvantages with off-farm labor, which reduces the technical efficiency of the farm, but increases the technical efficiency of the household (Fernandez-Cornejo, 2007). Off-farm work is responsible for poverty reduction in rural China and Vietnam with age, marital status, education, work, financial capital, land, location, market access, and losses from natural disasters being factors that contribute significantly to the decision to participate in non-farm employment (Duong *et al.*, 2021; Li *et al.*, 2021; Zantsi *et al.*, 2021). In Brazil, family farming faces problems related to insufficient technical assistance, especially in Bahia, where there is no governmental technical assistance. In addition, management problems in the coordination of government programs (National School Food Program (PNAE) and the Food Acquisition Program (PAA), for example) for the sector makes it even more difficult for farming families to support themselves with the income generated by food production.

3.2.3 *Physical factors*

Among the physical factors, soil quality was the most important (37.5%), followed by water availability (26.7%).

The soil of the plots of the Nova Vitória Association is predominantly dystrophic yellow argisil with a sandy-clay texture. For the success of crops such as corn, coffee, and cacao in full sun, these types of soil need to be well managed to increase their chemical fertility, maintain their physical qualities, and recover their biological vigor. The choice of crops affects the amount of nutrients exported from the soil, with particularly contrasting effects on NPK (Jobbágy; Sala, 2014).

Rainfall is well distributed throughout the year, but for irrigation, the available water is of questionable quality. The stream that could be used for agricultural purposes by the association runs downstream from the slurry of the Eunápolis garbage dump. With better ground cover management, the need for supplementary irrigation could be considerably reduced.

Climate ranked third with only 4.5% of the total citations. The region of Eunápolis has a year-round positive photoperiod, lots of rain, and temperatures varying from 25 to 34 °C, so it is possible to grow crops the entire year. Many other locations in the world at the same latitude with the same temperatures are dry. Although climate has not been a relevant factor in the choice of crops, the farmers of the Nova Vitória Association comment that, during the past three years, they have noticed atypical variations in the regional meteorological dynamics. The climate is a limiting factor that greatly affects crop choices around the world (Wassman 2009; Asrat *et al.*, 2010; Wang, 2010; Poudel; Shaw, 2016; Liliane; Charles, 2020). Crop diversification as a strategy for coping with climate risk depends primarily on a household's risk-taking capacity, which, in turn, depends on the household's asset level and perception of climate variability (Dercon;

Christiaensen, 2011; Stuart *et al.*, 2014). According to Seo; Mendelsohn (2008), the impact of climate change on net income is expected to reflect not only changes in production per harvest, but also in crop choice, which will cause South American farmers to switch from corn, wheat, and potatoes to squash, fruits, and vegetables.

3.2.4 Production factors

Production factors accounted for 9.5% of the citations. In other words, they had little influence on the choice of crops, a result that agreed with the study by Greig (2009). Among the production factors, crop yield was the most cited with 64.0%. Good crop yield implies better soil management, composting, crop treatments, and the choice of adapted matrices and seeds, which increases working time, financial investment, and the need for specific knowledge. In general, the application of inadequate agronomic practices, such as early planting, incorrect spacing, wrong planting method, inadequate sowing depth, late weeding, ineffective pest and disease control, improper use of fertilizers, early harvesting, and use of low-yielding varieties will always significantly reduce crop yields (Liliane; Charles, 2020). The members of Nova Vitória have little arable land available, with around 50% of the plots being legal reserves. Intensive agriculture is therefore a necessary strategy for economic viability of production on these plots. Intensive farming is a way of increasing productivity that generally has a positive effect on farmers' incomes. The reality of small production systems like this is that the high cost of chemicals reduces the profit margin to a level that is not feasible for people without access to financing and public support. Furthermore, intensive agriculture can be responsible for the loss of biodiversity and crop varieties (Omer *et al.*, 2007; Kremen *et al.*, 2012; Kremen; Miles, 2012; Brooker *et al.*, 2021), the worsening of water quality, salinization, erosion, and reduced soil and pollinator fertility (Tsiafouli *et al.*, 2015). In the short term, intensification of monoculture agriculture increases productivity. In the long term, there is a loss of important ecosystem services for agriculture (Foley *et al.*, 2005). Therefore, it is suggested that these farmers intensify their production models based on the agroecological precepts of stratification and diversification, maintenance of soil cover, use of resistant varieties, and on-farm production of bio-inputs.

3.2.5 Available resources

Available resources were least cited as important factors for the choice of crops (3%). This may be related to the fact that the Nova Vitória Association is a new settlement, and its owners have little or no access to financing. They do not have their own machinery, nor sufficient resources to purchase fertilizers. Access to agricultural techniques is still incipient, partly due to the Covid-19 pandemic, which was especially intense in Brazil. The availability of pesticides was the most often cited, at 37.7%.

Although the number of crops chosen because of pesticide availability is low, the use of pesticides is indiscriminate in the association's plots. The main pesticides used are: sulfluramid, deltamethrin, imidacloprid, beta-cyfluthrin, and glyphosate. This data is worrisome, but not unexpected, because since 2008 Brazil has become the largest consumer of pesticides in the world. The Brazilian government has yielded to pressure

from the multinational agrochemical industry, landowners, and the rural caucus in the National Congress, through actions such as tax exemptions, interruption of the industrial inspection processes, and relaxation of the rules for the use of pesticides (Frota; Siqueira, 2021). An example of this was the release of 474 new products in 2019 alone, and among the 50 most used, 22 have ingredients that were banned by the European Union (Frota; Siqueira, 2021). Adequate and healthy food are considered to be a human right, and the Brazilian State is obliged to ensure the food and nutritional security of its citizens, as established by the Federal Constitution. Therefore, it is necessary to expand the debate within society and the transparency of information, including toxicological studies that have been conducted and the criteria used for the authorization of new pesticides in Brazil (Lopes; Albuquerque, 2021).

3.3 Selection factors × principal crops

The data for the principal crops was cross-checked against the selection factors pertaining to them. The main existing crops were cassava (23.9%), banana (16.9%), and corn (12.7%), and crops desired for production were cacao (20.5%), banana (15.0%), passion fruit (10.9%), and black pepper (9.5%). Coffee (6.84%) was also included as a main crop to be considered because it has expanded greatly in other new settlements. Banana was mentioned in both categories (existing and desired) and, because the choice of factors was the same for each of the above categories, the average value was used (Figure 4). It is interesting to observe that the most important factor in the choice of the main crops was economic, followed by personal, physical, and production factors, and lastly available resources. This follows the trend of the general graph of choice factors (Figure 3).

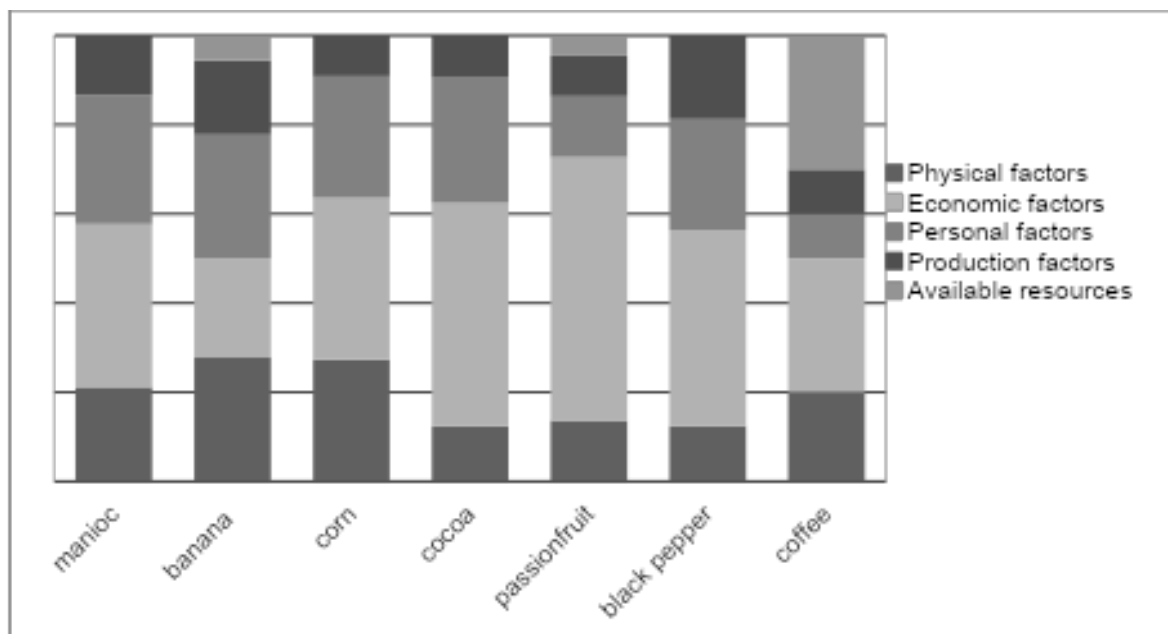


Figure 4. Factors influencing the choice of principal crops in the Nova Vitória settlement in Eunápolis, Bahia.

3.3.1 Cassava (*Manihot esculenta* Crantz.)

Cassava cultivation plays an important role in the context of family farming in Brazil and Bahia, where production in 2013 was estimated at 1.85 million tons of roots from a harvested area of 179,000 hectares, with average productivity of 10.35 t.ha⁻¹ (Noronha *et al.*, 2016). Access to the cassava matrix is easy and planting is usually done without fertilizer or compost. The use of non-resistant varieties, associated with successive cassava cultivation in the same area, without crop rotation or intercropping, is responsible for the increase in cassava diseases and steep drop in productivity. Varieties that are poorly adapted to the soil, climate, and pathogens are still used. The settlers, however, have neither the resources nor the knowledge to make fine adjustments in production, leading to low productivity. Another challenge faced by the farmers is the dependence on intermediaries or external partnerships with processing units to monetize the cassava production. This production is directed mainly towards the production of flour, because the cassava market, although more profitable and with higher growth potential, is still small. The initiatives to process cassava are incipient and cannot yet sustain a large network of suppliers.

3.3.2 *Banana (Musa sp.)*

Bananas were traditionally planted in *cabruças*² to provide shade for the cacao trees, and were not grown specifically for trade, but served mainly to feed the farmworkers. Today, banana intercropping with cacao has the potential to generate income, especially plantains and bananas *prata*, which have high demand and high market value. Both are suitable to provide the initial shade for the planting phase of the cacao, which will be conducted in full sunlight. Bananas, a highly perishable product, have logistic challenges for commercialization, which requires organization and coordination of sales. The banana crop is heavy and high-volume, and the farmers in the association do not have access to their own transport, being dependent on middlemen who buy their products at a fair price. Despite this, bananas have high production potential and can be used as raw material for the biomass agroindustry, or as chips, dried bananas, and sweets. High productivity, versatility and market acceptance are the main advantages of this crop.

3.3.3 *Corn (Zea mays L.)*

² “Cabruca” is a cocoa cultivation system in the middle of the Atlantic Forest, which is characterized by the use of shade from native trees to protect the cacao trees. situations, are not planted, partly because there are no more seeds available in the region, also because the market demands the characteristic shape of hybrid corn. The corn in the community is intended for sale during the religious festival of St. John’s Day, where corn and corn products are the main dish. In the local culture, the planting of corn is done on St. Joseph’s Day (March 19th) in order to have a good harvest of green corn during the festival of St. John’s Day (June 24th). Many producers follow these planting dates, which can put them in an unfavorable position at the time of sale. There is great demand, but the abundant supply of green corn causes the price to fall sharply. A strategy for green corn, in this case, would be a staggered planting schedule and a constant supply.

Easy access to corn seeds that promise high productivity provides incentive for its cultivation. However, corn requires good quality soil to be profitable. In this study, corn was among the most mentioned crops, however low productivity reduced its citations as a desired future crop. The lack of mastery of the technology necessary to meet the demand of modern hybrid corn varieties greatly reduces productivity in the association. Much is lost in production due to the lack of adequate lime and gypsum. The aluminum levels in the soil are a chemical barrier to the adequate development of the plant root system, which consequently suffers from water deficiency, despite the adequate distribution of rainfall in the region. The low natural chemical fertility of the available soils is not being compensated through fertilization. In the existing plantations in the association, there are deficiencies in calcium, potassium, phosphorus, and nitrogen, nutrients that are essential for corn. Even with high-production hybrid seeds, suitable for dense planting, large spacing (up to 1×1 meter) is used, which greatly reduces the crop yield. Creole corn varieties, which might be advantageous in these

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3.3.4 Cacao (*Theobroma cacao* L.)

Southern Bahia was, for a long time, one of the largest cacao producing regions in the world. It was characterized by monoculture plantations and extreme concentration of wealth. The cultural memory of cacao production in the region is strong. Many farmers who have settled in the region came from migrant families of the cacao exodus, which peaked in 1992 (Silva, 1995; Chiapetti, 2014). Many people left their homes in nearby cacao-producing regions, migrating to regions devoted to other types of cultivation. Before the crisis, social organization movements in southern Bahia were almost non-existent due to the political hegemony of the cacao property owners. Mobilization began to contest the former concentration of land and marginalization of workers, challenging the political power of these proprietors (Caldas; Perz, 2013). The memory of these people is that of cycles of wealth and work, despite all of the problems caused by the decline of cacao due to economic and climatic conditions, oversupply on the world market, and the fungal infection known as Witch's Broom. Witch's Broom is a disease caused by *Crinipellis pernicios* (Stahel) Singer, and is an example of the extreme vulnerability of a monoculture in a geographically extensive plantation with genetic homogeneity and an example of agroterrorism (Silva, 1995; Caldas; Perz, 2013; Chiapetti, 2014). Today, everything that is produced from cacao in the region has a market, from small to large yields. Although cacao is not sold directly to the mill, it is sold to the middleman at a discount rate lower than the price paid by the mill. Cacao is a commodity that offers great market solidity and liquidity. The big producers in the region invest in full-sun, irrigated cacao. The small farmers observe the success of this practice and get enthusiastic about producing cacao under full sun. Meanwhile, productivity is very low in the *cabrucas*, with old varieties that are susceptible to Witch's Broom. Reforming *cabrucas* is expensive and complicated, because most are located in areas that are difficult to manage. This is another factor that leads the cacao farmer to migrate to areas that are already open and easy to manage and mechanize. The producers of Nova Vitória are thinning the Legal

Reserve for cacao production in *cabruças*, which is not financially advantageous and is prohibited by Decree No. 15180/2014 of the State of Bahia that regulates the thinning of forest for *cabruça* cacao. In pre-established *cabruça* areas, the legislation allows for the removal of the remaining trees down to a minimum number of 40 per hectare. If the farmers of Nova Vitória follow this guideline, it would represent a very large environmental expense.

Cacao adapts well to agroforestry systems, which are production models that provide a greater diversity of income sources and have the potential to be resilient to climate change, when appropriate techniques of intercropping are applied. It is more profitable to establish cacao in agroforestry systems with high value-added trees such as mahogany, redwood, and cedar, and at the same time produce short-cycle crops. However, the technology of agroforestry systems is still little known by these farmers. They are not secure and do not see large producers working in this model. The low adherence to agroforestry systems by large producers is largely due to the dependence on labor. There is also a lack of financial incentives, either through specific financing for this productive model or through encouragement of the production processing and specific commercialization chains. A new process of regional productive specialization is emerging: the implementation of special forms of cacao production, especially certified organic cacao, a strategy to (re)insert itself into modern agricultural spaces, but which finds limitations caused by the technical, financial, and informational conditions of small farmers (Xavier *et al.*, 2021).

3.3.5 *Passion fruit (Passiflora edulis Sims)*

Passion fruit is an interesting crop for family agriculture in small areas because it has high productivity and good sales price if it is well managed. There are large producers in the region and buyers in the fruit pulp industry. The market is relatively well established. Passion fruit, however, demands a high investment in trellises built with wire and stakes (high cost of wood). In small passion fruit cultivations in the association, wood from the Legal Reserve is used for the trellises, which increases the pressure on this environmentally preserved area. The average production cycle of passion fruit in the region is one year, mainly due to the incidence of soil fungus, propagated through the plantation by the intense use of the harrow as a method of weed control, data that agrees with that from EMBRAPA (2021). In addition, the very humid climate during the cooler part of the year increases the occurrence of fungi in the aerial part of the plant. Passion fruit in these areas also needs increased nitrogen, phosphorus, and potassium in order to sustain adequate production. The presence of the producer in the field is constantly required, in order to observe pests and the manual pollination time, thereby increasing productivity.

3.3.6 *Black pepper (Piper nigrum L.)*

Black pepper was more cited as a desired crop than as an existing one, because it must be planted with a view to the long term. As the members of the association were not certain of land ownership, this crop was not planted initially because the investment required is significant. Black pepper in the region has reliable sales market, regardless of the quantity produced. Processing is easy, with no need for expensive machinery. The pepper is dried in the sun and there are no storage requirements, because it is not very perishable. The volume for transportation is relatively small and the selling price varies greatly, from US\$ 1 to US\$ 6/ kg. However, it does require a lot of labor and the cost of planting is high, because stakes of resistant wood are required, which must be able to last 20 years, the approximate production time of this crop. As a strategy to reduce the cost of black pepper cultivation and the pressure of wood extraction from the Legal Reserve, live stakes such as gliricídia (*Gliricidia sepium* (Jacq.) Walp.) and moringa (*Moringa oleifera* Lam.) are suggested to be planted. Live stakes have the potential to drastically reduce the financial capital needed for the implementation of the crop, especially if the farmers outline a strategy for producing their own mother plants, either by planting a reduced number from which new cuttings can be harvested, or by planting live cuttings from seedlings that have been grown from seeds. Moringa has been shown to be adapted to this method of implantation. Besides being cheaper to plant the pepper on live stakes, the leaves serve as fertilizer and shade for the pepper plant, reducing dependence on irrigation.

3.3.7 *Coffee (Coffea canephora* Pierre ex Froenher)

Coffee production has expanded in the region due to the exodus of farmers from Espírito Santo, a neighboring state, which has a significant coffee production. This exodus is mainly due to the increasingly intense drought in the mountainous areas of the region (Pezzopane *et al.*, 2010; Bliska *et al.*, 2021). These farmers migrated north to areas of southern Bahia in search of water. The high yield and income of these farmers facilitated the sale of this crop with the presence of trading companies and cooperatives in the region. There is high risk in coffee production, being one of the factors that has decreased its cultivation in some regions (Kwanmuang *et al.*, 2018). Coffee has a single annual harvest, generating financial inflow once a year, but with continuous financial outflow. The price fluctuates from one year to the next due to international factors, so low supply locally does not imply a higher price. When combining years of low production with extreme weather events or a pathogen attack, the entire crop may be lost, causing enormous losses to family farmers. During the coffee harvest season, there is competition for labor among the large producers in the region, making it scarce and expensive. This is when many of the members of Nova Vitória work, which provides them with an annual source of income other than what they make from their own lot. Labor is a limiting factor in many parts of the world. Kwanmuang *et al.* (2018) state that, in Thailand, a decrease in the creation of new coffee plantations as well as the maintenance of old ones is mainly affected by the lack of available labor for harvesting. Other negative points for coffee in small farms are that planting coffee in full sun and as

a monoculture requires a great deal of management, crop treatments, and pesticides, which put the quality of life of these workers at risk.

4. Conclusion

The preferred crops by farmers of Nova Vitória Association in Eunápolis, Bahia, were found to be cassava, banana, passion fruit, corn, cacao, black pepper, and coffee. Among the seven main desired crops, three of them (cacao, black pepper, and coffee) are commodities. This study points out a preference for commodities and cash crops planted as monocultures, and the virtual inexistence of subsistence crops. The economic factors are paramount in the choice of crops especially when referring to marketability and product price. In addition, land ownership, the need to pay for the land, off-farm labor, low income and education, lack of technical assistance, the pollution of watercourses, and cultural aspects shape the choice of crops. These results are worrisome when taking into account that these people are already food insecure. Knowing the crops chosen by farmers and the key factors involved in this choice is important to understand the changes in land use and to point out deficiencies in agricultural strategies and issues related to the social, environmental, and food security of these farmers. Agricultural biodiversity, coexistence of cash and subsistence crops, access to credit and technical assistance, access to information about agroecological practices and integrated management are fundamental to minimize the disparity in the key factors presented and to seek balance.

Esses resultados evidenciam a influência do estado do material vegetal, fresco ou seco, na concentração e atividade dos compostos bioativos, ressaltando a necessidade de otimizar técnicas de secagem. Além disso, reforçam o papel da pesquisa científica na validação do uso tradicional de plantas medicinais, destacando o potencial dessas espécies para aplicações na prevenção de doenças relacionadas ao estresse oxidativo.

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