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COMMUNITY ERGONOMICS AND SUSTAINABILITY IN RURAL AGROECOLOGICAL COMMUNITIES

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SUMMARY: Community Seed Banks (BSC), collective spaces used to store community stocks of native seeds, managed by farmers, guaranteeing seeds for planting and contributing to biodiversity conservation. This article sought to analyze the stocks of native seeds in Community Seed Banks in the municipality of Queimadas-PB and propose strategies for conserving biodiversity and the cultural and genetic heritage of farmers. Qualitative and quantitative situated research was carried out, using the Community Seed Bank Monitoring System. The 13 BSC of Queimadas have 364 members and serve 443 farming families, storing 1,650 kg of seeds distributed in 8 species (starter beans, macassar/string beans, broad beans, corn, forage, fruit, oilseeds and tubers) and 57 varieties . Corn is the most representative species in terms of stored volume, with 670 kg, representing 41%, followed by starter beans, with 320 kg (19%) and macassar beans/string beans, with 312 kg (19%). Among the 57 varieties, 22 were classified as critical stocks (EC ≤ 2 kg), six of which were starter beans, five macassar/string beans, four broad beans, two forage crops, two oilseeds, one variety of fruit and one of tuber. Based on the analysis of Creole seed stocks in Queimadas and the BSC Network of the Borborema Territory, action strategies were established to conserve biodiversity and guarantee seeds for family agroecosystems in the region, including: implementation of multiplication fields, exchange of seeds between BSC, external contributions and control of stock movement.

KEYWORDS: Creole seeds; Community seed banks. Biodiversity. Participatory ergonomics; Community ergonomics.

INTRODUCTION

Since the last decades of the 20th century, changes in behavior between man and nature can be observed, that is, hunting and gathering began to be replaced by agronomic practices, with this, the domestication of many existing species began. in Planet. From this, human beings began an activity of natural selection of species, starting agricultural activities, leading to plant improvement, even if empirically (GARBIN, 2015). Consequently, from the first agricultural

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practices to the present day, improvement has been carried out through different practices and human needs, since the management of varieties of species contributes to the sustainability of agricultural systems.

On the other hand, at the beginning of the 20th century, more specifically, after the Industrial Revolution, species and varieties began to be replaced quickly, causing fluctuations in the agricultural landscape, as well as influencing the products and the way they were consumed (PELWING; FRANK; DE BARROS, 2008). From the 1950s onwards, the Green Revolution began, based on the intense use of pesticides and synthetic fertilizers in agriculture with the aim of increasing productivity through research into seeds, soil fertilization, use of pesticides and agricultural mechanization (SERRA et al. , 2016). According to Pinheiro et al (2000), the high international demand for food after the Second World War led to the Green Revolution being enhanced as a way of expanding production, implementing mechanical practices, high-yield varieties and chemical inputs. This production model generated negative impacts on nature, with soil impoverishment, deforestation, erosion, rural exodus, loss of biodiversity, use of pesticides that harm human and animal health, causing great environmental impact.

Subsequently, new technologies emerged that sought genetic improvement, with private investments in research. However, seeds genetically improved in research centers are highly vulnerable to environmental stresses and attacks from insect pests and diseases, and were developed to reach their productive potential when grown under "optimal growing conditions", only achieved through employment of the modern technological arsenal of industrial agriculture through the alteration of agricultural environments with the use of chemical fertilizers and irrigation (ALTIERI, 2002; GAIFAMI; CORDEIRO, 1994, apud, LONDRES, 2014), predominantly oriented towards maximizing physical productivity of crops (PETERSEN et al., 2013). Furthermore, farmers, in general, lost the ability to control the reproduction of seeds, making them dependent on the companies that sell them (SILVA et al., 2009).

On the other hand, many farmers, especially family farmers and other traditional people, continued to cultivate and preserve Creole seeds, many of which were naturally improved, adapting to the environment and management practices (GARBIN, 2015). These seeds, preserved by farmers, are called traditional, ancient, homemade, Lantrance or Creole varieties. In Paraíba, these seeds are called Passion Seeds.

Creole seed is a term that is not only directed at seeds, but can also be attributed to tubers (potatoes, cassava, etc.), in addition to other foods. Seeds go far beyond the meaning of food, incorporating sociocultural practices of each community, because through seeds, aspects of people's culture and way of living are expressed, highlighting the importance of food, the maintenance of local cultures, as well as, the conservation of the genetic heritage of nature that farmers hold (ALVES; MARQUES; MENDONÇA, 2011).

According to Petersen et al. (2013), native seeds have high variability in biological characteristics, greater horizontal resistance to environmental stresses and better adaptability to the regions in which they are cultivated, as they are improved through natural selection. Therefore, according to these authors, the cultivation of native seeds is essential for the application of the agroecological perspective in the management of ecosystems and for the defense and promotion of agrobiodiversity. They also highlight that it is in family farming that a greater variety of Creole seeds are preserved. Furthermore, according to Trindade (2007), when storing native seeds, farmers do not need to buy commercial seeds, which do not have the same resistance and adaptability to the regions in which they will be grown.

The cultivation of different varieties of the same species is used as a strategy by agroecological family farmers, as diversity is a great promoter of resilience in production systems, increasing their resistance to pest and disease attacks and climate variations (LONDON, 2014). According to the author, over time, seeds evolve and adapt to the

environment and management practices, also contributing to the exchange of seeds between rural communities.

Therefore, the conservation of the diversity of native seeds is fundamental, avoiding the loss of varieties and genetic erosion. Different forms of conservation have been developed, and can be divided into two basic strategies: ex situ and in situ (DULLOO, et al (2010). In situ conservation is defined by the Convention on Biological Diversity (CBD) as the maintenance of species in the their natural habitat (UNCED, 1992). Ex situ conservation of seeds, according to the (CBD), is that which occurs outside their natural habitat (UNCED, 1992). According to Dulloo et al. (2010), the main The objective of ex situ conservation is to keep seeds alive and reduce degeneration, which can cause loss of genetic diversity, and the main method of conservation is the use of seed banks. Conservation in seed banks requires that the seeds are droughts, with their longevity being influenced by some factors, such as temperature and relative humidity and moisture content of the seeds (ELLIS; ROBERTS, 1980).

This article addresses the ex situ conservation of native seeds, more specifically, the conservation of seeds through Community Seed Banks (BSC), managed by farmers, which constitute an important tradition practiced by many rural communities. BSC are spaces used to store collective seed stocks, ensuring availability of seeds for planting at the “right time”. They bring with them the proposal to conserve seed diversity, valuing gestures of solidarity between farming families, constituting a form of resistance against public policies that distribute seeds of commercial varieties with no link to the families' stock strategy in seed banks. seeds, nor with the environmental and soil characteristics of the region. Farmers who conserve seeds in family and/or community banks are called seed guardians, being responsible for conserving agrobiodiversity and knowledge that is passed from generation to generation.

This article aims to analyze the BSC seed stocks in the municipality of Queimadas-PB and propose strategies for the conservation of biodiversity and the cultural and genetic heritage of family farmers. This article is part of the multidisciplinary Research and Development Project – R&D “Monitoring the agrobiodiversity of species and varieties of landrace seeds in the Network of Seed Banks in the Territory of Borborema-PB”, developed by DEP-PPGEPS-UFPB in partnership with ASPTA and the Seed Commission of the Borborema Territory BSC Network, which aims to design, develop and implement a Monitoring System for biodiversity and native seed stocks in Seed Banks (SALDANHA, SANTOS, SILVA; 2017), contributing to biodiversity conservation and local development.

COMMUNITY ERGONOMICS

Community ergonomics arose from the need to develop solutions to socioeconomic problems involving poor communities in American cities (COHEN, 2000; DERJANI-BAYEH, 2000), such as: low self-regulatory control, lack of environment-community adequacy, isolation social and dependence on government social programs (COHEN; SMITH, 2001). Later, it began to have applications in productive organizations, driven by the contributions of Ergonomics, Human Factors, Macroergonomy, Industrial Engineering, among others (COHEN, 2000; DERJANI-BAYEH, 2000),

For Schmitz (2000), community ergonomics aims to improve the relationship between people (customers and employees) and society so that they can achieve higher levels of social integration, seeking to reduce social isolation. To have a good development of community ergonomics, it is necessary to have innovative thinking, which seeks to develop activities that seek community ergonomic strategies, involving people, using information and knowledge, providing changes and improvements within a community (SMITH; SMITH, 1994).

Community ergonomics "is a bottom-up participatory approach that incorporates ergonomic concepts", based on spaces for collective dialogue, which allow the community to

identify themselves (SCHIMITZ, 2000), discuss and solve their problems collectively (SILVA et al ., 2015).

In this context, the relationship between the precepts and methodology of community ergonomics in the development of the Seed Bank monitoring system is observed, as the project has been developed in a participatory manner, with the objective of contributing to the improvement of community practices that have been developed by family farming communities, with the aim of conserving the region's cultural genetic heritage and community practices.

METHODOLOGY

The system for monitoring stocks and biodiversity of native seeds in Community Seed Banks originated from a management demand from ASPTA, resulting from an existing working partnership between UFPB and ASPTA, together with the agroecological communities of the Territory of Borborema-PB . The demand was related to optimizing seed monitoring.

The design and implementation of the Seed Bank (BS) monitoring system is being conducted through Participatory Ergonomics (HENDRICK &KLEINER, 2006; DANIELLOU, 2002; VIDAL, 2003; SALDANHA, 2004), Macroergonomy (HENDRICK &KLEINER, 2006) and of Community Ergonomics (COHEN, 2000; DERJANI-BAYEH, 2000; SCHIMITZ, 2000).

The conception and modeling of BSC Monitoring took place in a real work situation characterized by the unique combination of organizational aspects (context, tradition, culture, forms of organization, partnerships, technical cooperation), technological aspects (involved in agroecosystems and seed banks) and, the people (skills, experience, knowledge, values, individual and collective culture), involved in the activities of the BSC's, which develop in the midst of a given context (agroecological-based family farming in the semi-arid region of northeastern Brazil). It was characterized by the cooperation and participation of the various actors involved in the socio-technical construction process, in which an attempt was made to consider the specific reality of family farming communities distributed across the 12 municipalities, to incorporate the unique experiences experienced by these people, to value culture and tradition and its socio-economic-organizational and cultural context.

It required an intense Social Construction (CS) process, which included all the people who participated in the different moments of modeling, involving the Borborema Territory BSC Network and the institutions that support agroecological family farming in the Borborema Territory, ASPTA (Advisory and Service to Project in Alternative Agriculture), the Borborema Hub, formed by the articulation of unions from the 12 municipalities involved in agroecological-based family farming, the state and federal universities of Paraíba, Embrapa.

Location

The research was carried out in the Territory of Borborema, located in the semi-arid region of the state of Paraíba-Brazil, together with the BSC Network of the Territory of Borborema-PB, which comprises 61 BSC distributed in 12 municipalities involved in agroecological-based family farming: Queimadas (13), Solânea (8), Areial (6), Casserengue (6), Remígio (5), Massaranduba (7), Alagoa Nova (4), Arara (3), Esperança (3), Montadas (2), Lagoa Seca (2) and Lagoa de Roça (1).

Initially, a survey was carried out among the 61 BSCs that make up the BSC Network, to survey the diversity of species and varieties and their stocks. Secondly, the research focused on the municipality of Queimadas, as it is ranked as the highest in terms of number of BSC (13), members, families served and diversity of seed varieties, and second in terms of stock volume and number of species. .

Data survey

The data collection with the BSC took place in a situated and participatory way, involving professors and students of production engineering and agroecology from UFPB, technical advisor from ASPTA (Family and Agroecological Agriculture), managers and farmers who are members of the Seed Commission of the BSC of the Territory of Borborema-PB and members of the Farmers Unions.

It involved visits to the 61 BSC, of the 12 municipalities that make up the BSC Network (Alagoa Nova, Arara, Areial, Casserengue, Esperança, Lagoa de Roça, Lagoa Seca, Massaranduba, Montadas, Queimadas, Remígio and Solânea) and participation in meetings of the Seed Commission of the Borborema Territory BSC Network, which help to understand the context. Observational and interactional methods were used (conversational actions, spontaneous and provoked verbalizations), mediated by specific forms developed for data collection.

In addition to information regarding the banks' seed stock, qualitative information was collected regarding the number of members; families served; storage capacity; ways of storing and conserving seeds, equipment; seed quality; use of monitoring notebooks and the main difficulties and challenges faced by BSC. Regarding the movement of seeds in each BSC, the entry and exit of each variety were identified in the different modalities, which are:

- loan/return of seeds for use in the fields, by farmers;
- contribution from the mother bank;
- contribution from institutional projects;
- external field of multiplication (of salvation);
- internal multiplication field;
- exchange of seeds between BSC or Exchange Fairs;
- marketing (buying or selling).

Data analysis

After the data was collected, it was tabulated, using the BSC Monitoring System (SALDANHA, M.C.W; SILVA, E. D. ; SANTOS, T. S., 2017), generating information in the form of tables and graphs.

It should be noted that the classification of species in the Monitoring System was developed based on the classification adopted in local agroecosystems, different from the botanical classification. Thus, the Monitoring System currently comprises 11 species, which are: starter beans, macassar beans, broad beans, pigeon peas, corn, forage, vegetables, oilseeds, tubers, fruit plants and flowers.

To analyze the stocks, the classification developed by the Monitoring System for BSC (Table 1) was used, which defines the scores for the stocks of each BSC, Municipality and Territory.

Table 1- Classification of Stocks of seed varieties in BCS and, Municipalities/Territory

Classification	Score Municipality/Territory	Score Community Bank
High Stock - EE	EE ≥ 500kg	EE ≥ 100kg
Good Stock - EB	100kg ≤ EB < 500kg	30kg ≤ EB < 100kg
Regular Stock - ER	30kg ≤ EB < 100kg	-
Low Stock - Ebx	2kg < Ebx < 30kg	2kg < Ebx < 30kg
Critical Stock - EC	EC ≤ 2kg	EC ≤ 2kg

Source: Community Seed Bank Monitoring System – SALDANHA et al; 2017

The use of colors for classification was developed so that the result would become more understandable by BSC managers and other users who use the system as a BSC management tool. This classification was developed in a participatory manner and the results were validated by technicians, partner institutions, researchers and BSC managers.

Establishment of action strategies

The action strategies are based on the classification of stocks in the BSC, municipalities and Territory, the seed movement modalities and aim to conserve biodiversity and are discussed at meetings of the Seed Commission of the Seed Bank Network. Based on these discussions, BSC managers together with associates establish action strategies for each BSC according to their reality and context.

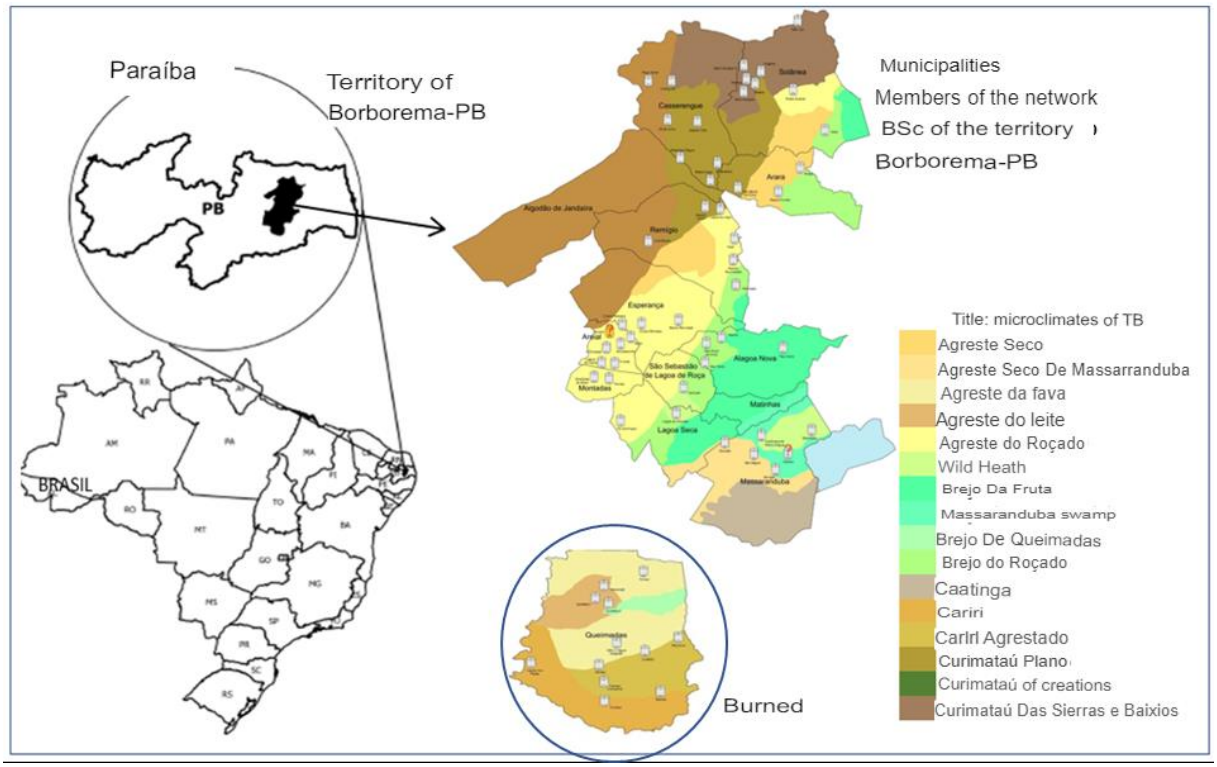
DEVELOPMENT

BSC Network of the Territory of Borborema-PB

The Borborema Territory is located in the semi-arid region of Paraíba, characterized by environmental contrasts that occur in the form of a drought cycle. The climate is hot and humid, with temperatures between 15 and 22 ºC and rain between the months of February and August. Rainfall averages in the range of 800 to 1000 mm. The dry period lasts 5 to 6 months. The soils are deep and fertile and the hydrography is characterized by small and medium-sized watercourses, with oscillation in water flow between dry and rainy periods, classifying it as semi-perennial (PTDRS, 2010). The Borborema Territory is characterized by a diversity of micro-climates that present different characteristics (Figure 1), impacting the characteristics of agroecosystems, types of production and cultivated species and varieties.

The Territory is made up of 21 municipalities, of which, in 12, agroecological practices have been implemented with family farmers. These 12 mini-municipalities are part of the BSC Network of the Territory of Borborema-PB, which has 61 Community Seed Banks, distributed in 12 municipalities, as follows: Queimadas (13), Solânea (8), Massaranduba (8), Areial (6) , Casserengue (6), Remígio (5), Alagoa Nova (4), Arara (3), Esperança (3), Montadas (2), Lagoa Seca (2) and, Lagoa de Roça (1), (Figure 1) .

Figure 1 – Territory of Borborema-PB, municipality of Queimadas, location of BSC and microclimates



The seed stock in the BSC Network of the Territory of Borborema-PB (data beginning of 2020) was 9,269.27kg distributed in 11 species and 145 varieties. The Network has 1,061 members and serves approximately 1,490 farming families (Table 2).

Table 2 – Global information from the BSC Network in the Borborema-PB Territory

Nº	Counties	BSC	Associates	Families Served	Species	Varieties	Municipal Stock		
							Kg	%	Accumulated
7	Solânea	8	93	93	7	30	1.708,49	18,43	High 8.131,77kg 87,76%
	Queimadas	13	346	443	8	57	1.638,90	17,68	
	Casserengue	6	66	140	6	26	1.503,06	16,22	
	Remígio	5	64	108	9	42	1.099,68	11,86	
	Alagoa Nova	4	70	66	6	17	801,00	8,64	
	Areial	6	72	58	4	16	756,88	8,17	
	Arara	3	74	56	10	53	623,77	6,73	
3	Montadas	2	49	87	7	21	426,70	4,60	982,60 10,60%
	Massaranduba	8	133	122	9	36	280,00	3,02	
	Esperança	3	67	53	5	31	275,90	2,97	
2	Lagoa Seca	2	22	258	7	12	91,90	0,99	154,90 1,67%
	Lagoa de Roça	1	6	6	3	4	63,00	0,68	
	Total	**61**	**1.062**	**1.490**	**11**	**145**	**9.269,27**	**100,0**	

Caption: Stock Classification: High;; Good; Regular; Low; Critical

Queimadas is the municipality with the largest number of BSC, members, families served and diversity of seed varieties and the second in terms of stock and number of species (Table 2). Due to these characteristics, it was chosen for analysis in this work

The municipality of Queimadas was founded in 1961 and has 44,179 inhabitants, approximately 45% of whom live in rural areas. It has 3,299 family farming establishments and 8,809 family farmers, corresponding to 20% of the population. The per capita income in 2010 was R$283.93 and the HDI (Human Development Index) was 0.608, classified as low, characterizing serious socioeconomic problems (IBGE, 2010).

The 13 BSC are located in the following microclimates: cariri agrestado (4 BSC), agreste da fava (3 BSC), agreste do Leite (1 BSC) and cariri (5 BSC) (Figure 1). They have 364 members and serve 443 farming families. The seed stock is 1,638.90 kg distributed among 8 species (starter beans, macassar beans or string beans, broad beans, corn, forage, fruit, oilseeds and tubers) and 57 varieties (Table 3).

Table 3 – Global information from the BSC in the municipality of Queimadas-PB

BSC	Microclimate	Associates	Families Served	Species	Varieties	Stock	
						Kg	%
BSC 1	Agreste da Fava	52	67	5	21	475,90	29,04
BSC 2	Agreste do Leite	48	80	6	18	442,20	26,98
BSC 3	Cariri Agrestado	22	32	4	9	210,25	12,83
BSC 4	Cariri Agrestado	15	22	5	9	102,00	6,22
BSC 5	Agreste da Fava	20	20	6	13	73,20	4,47
BSC 6	Cariri	40	30	3	9	70,50	4,30
BSC 7	Cariri	48	48	5	9	59,60	3,64
BSC 8	Cariri	30	27	4	9	53,50	3,26
BSC 9	Cariri Agrestado	12	31	4	6	49,50	3,02
BSC 10	Cariri Agrestado	18	28	1	1	48,00	2,93
BSC 11	Cariri	9	8	3	8	38,75	2,36
BSC 12	Agreste da Fava	18	18	3	3	15,50	0,95
BSC 13	Cariri	32	32	0	0	0,00	0,00
Total		**364**	**443**	**8**	**57**	**1.638,90**	**100**

Caption: Stock Classification: High;; Good; Regular; Low; Critical

The seeds are stored in PET bottles, drums or silos, where labels are attached with information about the variety, name of the member, year of entry of the seed into the BSC. To preserve the seeds, farmers use natural products, such as black pepper, dried orange peel or ash. (Figure 2)

Figure 2: BSC of Queimadas-PB

The BSCs are managed by the farmers themselves, one of whom plays the role of a manager, who is part of the Seed Committee of the BSC Network of the Territory of Borborema-PB. Decisions are made collectively at three different levels: BSC, municipality, Territory. Therefore, periodic meetings are held with BSC members, meetings with BSC

managers who are part of the municipality's BSC committee and the Territory's BSC Network, where problems, potentialities and strategies are collectively defined. The Meeting of Guardians and Seed Guardians of the Borborema Territory is held annually, where the results of the work carried out in partnership with the institutions are presented, training lectures, good practices carried out in BSC and action strategies are established. The event hosts a seed exchange fair, encouraging the exchange of seeds and knowledge.

The main difficulties reported by BSC managers from the Territory's BSC Network are related to drought, GMO contamination and rural violence. The consecutive years of drought and the absence of means of irrigating the fields generate low productivity in production, impacting the return of seeds to the BSC. Contamination of landrace corn seeds by transgenic seeds also constitutes a threat to the genetic diversity of landraces in the region. Studies carried out by ALBUQUERQUE; SILVA; ANTUNES (2020) shows that in 2018, of the 141 samples of creole corn, coming from different agroecosystems in municipalities in the Territory of Borborema-PB, where creole varieties were planted, 67 (47.5%) obtained a positive result, that is, contaminated with transgenic proteins. Violence in the countryside and the growing number of robberies and assaults have caused a rural exodus, that is, many families have migrated to the cities, impacting the number of members in banks.

Analysis of Stocks and Seed Diversity in the Queimadas BSC

Among the 13 BSC of Queimadas, differences were identified in the volume and diversity of seeds. It is observed that two BSC represent 56% (918.10 kg) of the municipality's stock, while 8 banks represent 24.93% of the total stock of Queimadas. According to the stock classification, four BSC have high stocks (EE), varying between 102.00 and 475.90 kg, totaling 1,230.35 kg, which represents 75% of the municipality's stock. Seven BSC were classified as good stock (EB), with values varying between 38.75kg and 73.20kg, totaling 393.05kg, which represents 24% of the stock. Only one bank had low stock, with a value equal to 15.50kg, representing 0.95% of stock. A BSC did not have its inventory accounted for. (Table 3).

Regarding diversity, 8 species and 57 varieties were identified. The number of species among the BSC varied between 1 and 6, with 3 BSC having 5 species. The number of varieties varied between 1 and 21, with 9 varieties being the highest frequency, in 5 banks.

BSC 1 has the largest stock (475.90kg), representing 29.04%, and the greatest diversity, having 21 varieties distributed in 5 species (starter beans, macassar beans/string beans, broad beans, corn and forage beans) . BSC 2 has the greatest diversity (6) of species (6), starter beans, macassar beans or string beans, broad beans, forage corn and oilseeds, and second in number of varieties (18). In contrast, BSC 10 has only one species and one variety (Table 3)

Corn is the most representative species in terms of volume, with 669.90 kg, representing 41% of the stock, with 6 varieties, followed by starter beans, with 319.96 kg (19%) and 14 varieties, and Macassar beans/string beans with 311.80 kg (19%) and greater diversity, 18 varieties. The most representative species in the municipality as they are present in a greater number of BSC are: Corn and Macassar/Rope Beans in 11 BSC, Fava Beans in 10 BSC and Starter Beans (9). These species are traditionally cultivated in annual fields, being used in family food and commercialization, with corn also being used in animal feed. Oilseeds, fruit plants and tubers are species that have recently begun to be stored in BSCs, being present in few BSCs and with small stocks (Table 4).

Table 4 - Species and Varieties of landrace seeds from BSC in Queimadas-PB

Species	Nº BSC	Varieties	Stock	
			Kg	%

Corn	11	6	669,90	40,87
Starter Beans	9	14	316,96	19,34
Macassar Beans or String Beans	11	18	311,80	19,02
Forage	4	4	178,25	10,88
Fava	10	11	161,55	9,86
Oilseed	1	2	0,20	0,01
Fruit bowl	1	1	0,20	0,01
Tubers	1	1	0,05	0,003
Total	**13**	**57**	**1.638,91**	**100**

Caption: Stock Classification: High;; Good; Regular; Low; Critical

Among the 57 varieties, only one, jabatão corn, showed high stocks (EE > 100 kg), three showed good stocks (100kg ≤ EB < 500kg), black starter beans, evergreen macassar beans and white sorghum forage, and seven varieties have regular stock (30kg ≤ EB < 100kg). On the other hand, 25 varieties have low stocks (2kg < Ebx < 30kg), 5 of which are starter beans, 5 are macassar/rope beans, 2 are forage, 4 are broad beans, 1 is fruit, 2 is oilseed and 1 is tubers and, 22 are classified as critical stock (EC ≤ 2.00kg), 06 of which are starter beans, 05 of macassar/rope beans, 04 of broad beans, 02 of forage, 02 of oilseeds, 01 variety of fruit plants, and tuber. (Table 5)

Action Strategies for biodiversity conservation

BSC BSC stock monitoring enables the development of action strategies for the conservation of the region's biodiversity. The main strategies are related to seed movements and comprise: Mother Bank contribution, seed exchange, external (salvation) or internal multiplication fields, seed marketing (purchase and sale), storage time control.

Table 5 presents the inventory of species (8) and varieties (57) in each BSC, the inventory of the municipality of Queimadas and their stock in the BSC network of the Borborema territory, consisting of 61 banks, classified according to their stocks (high, good, regular, low and critical). The analysis of this information contains so that the managers and associates of the municipality's BSCs establish action strategies, according to their needs and priorities.

It is noteworthy that the results of the BSC monitoring system, published and made available in the BSC Borborema BSC Creole Seed Yearbook and the seed notebooks of each bank, allow the mapping of the seeds, allowing managers and managers and Associates can identify the location (s) in which each variety is stored and, that is, the identification of the municipality and BSC where each variety is stored and their inventories, enabling the rescue of varieties lost by communities and expansion of diversity BSC and agroecosystems. Thus, the monitoring of the BSC network, enables the exchange of seeds between BSC, rescuing and expanding regional biodiversity.

Table 5: Stock of landrace seed species and varieties in the BSC in the municipality of Queimadas and in the Territory of Borborema-PB

Species	Variety	BSC Burning Stock (KG)													Stock Territory	% Queim
		BSC1	BSC2	BSC3	BSC4	BSC5	BSC 6	BSC 7	BSC 8	BSC 9	BSC 10	BSC 11	BSC 12	BSC 13	Total	
Corn (19)	Jaboatão	245,70	158,00	27,00	36,00		32,00		24,00	4,00	48,00				574,70	1.147,20	50,10
	Pontinha					40,60				10,50					51,10	1.246,55	4,10
	Gabon							20,00							20,00	126,00	15,87
	Uberabinha								14,00						14,00	14,00	100,00
	Corn												7,60		7,60	190,60	3,99
	Ibra						2,50								2,50	22,50	11,11
	Total	**245,70**	**158,00**	**27,00**	**36,00**	**40,60**	**34,50**	**20,00**	**38,00**	**14,50**	**48,00**		**7,60**		**669,90**	**3.227,14**	**20,76**
Starter Beans (34)	Black	22,80	54,00	36,00	5,00	5,00		18,50		20,00					161,30	890,65	18,11
	Mulatinho		30,00	4,00					2,00						36,00	114,75	31,37
	From Rio	5,00	6,00					8,50				15,30			34,80	1.624,55	2,14
	Carioquinha de Cacho	23,00													23,00	129,33	17,78
	Fat White	1,00		20,00											21,00	24,60	85,37
	Fat				3,00			1,03				10,25			14,28	28,58	49,97
	Black Berabinha									10,00					10,00	43,60	22,94
	Rolled Egg	2,00	2,00			1,00		0,88				0,20			6,08	119,71	5,08
	Faveta	1,00							1,00						2,00	184,50	1,08
	Fire in the Mountains		2,00												2,00	3,70	54,05
	Fat Blue	2,00													2,00	3,90	51,28
	Laundrywoman				2,00										2,00	7,50	26,67
	Pork Tripe *		2,00												2,00	**2,00**	100,00
	Rosinha					0,50									0,50	72,20	0,69
	Total	**56,80**	**96,00**	**60,00**	**10,00**	**6,50**		**28,91**	**3,00**	**30,00**		**25,75**			**316,96**	**3.729,67**	**8,50**
Macassar Beans or String Beans (23)	Always green	95,50	53,00	18,00		3,65			1,50			3,65			175,30	394,15	44,48
	Macassar	1,70	11,00	16,00	4,00			8,75		4,00			7,00		52,45	359,70	14,58
	Ballast						15,00								15,00	15,00	100,00
	Cow rib	2,00				11,20						0,05			13,25	33,55	39,49
	little owl	2,00	5,00				4,00								11,00	51,05	21,55
	Half Rama					2,00	4,00								6,00	6,00	100,00
	Chico Jorge	5,90													5,90	7,90	74,68
	Blue					4,00									4,00	4,00	100,00
	Golden Beak				4,00										4,00	8,80	45,45
	Cariri			4,00											4,00	96,55	4,14

	Chicken Fig						4,00							4,00	15,10	26,49
	Pork tripe		4,00											4,00	4,00	100,00
	White	3,60												3,60	68,60	5,25
	Moita						2,00							2,00	12,70	15,75
	Uranium *		2,00											2,00	**2,00**	100,00
	Red											2,00		2,00	14,45	13,84
	Guinea Beard					1,70								1,70	5,60	30,36
	Canapé *	1,60												1,60	1,60	100,00
	Black	6,00												6,00	6,00	100,00
	Total	**112,30**	**75,00**	**38,00**	**8,00**	**22,55**	**29,00**	**8,75**	**1,50**	**4,00**		**5,70**	**7,00**	**311,80**	**1.119,15**	**27,86**
Fava (29)	Grandma's Ear	33,50	46,00			2,50		0,85	5,00			2,50		90,35	279,65	32,31
	White	15,60	2,00		10,00	0,50	5,00	0,90	2,00				0,90	36,90	57,30	64,40
	Girl's Mouth					0,50			2,00			4,80		7,30	55,30	13,20
	Butter		5,00				2,00							7,00	12,25	57,14
	Sheep's Eye	5,00												5,00	6,00	83,33
	Rama's Broad Face	4,00												4,00	166,63	2,40
	Inga				4,00									4,00	4,00	100,00
	Bahia *	2,00												2,00	2,00	100,00
	Washer *								2,00					2,00	2,00	100,00
	Gust *				2,00									2,00	2,00	100,00
	Girl's Finger *									1,00				1,00	1,00	100,00
	Total	**60,10**	**53,00**		**16,00**	**3,50**	**7,00**	**1,75**	**11,00**	**1,00**		**7,30**	**0,90**	**161,55**	768,96	**21,01**
Forage (13)	White Sorghum			85,00	32,00									117,00	121,00	96,69
	Channel Sorghum		60,00											60,00	72,00	83,33
	Black Sunflower **	1,00												1,00	2,00	50,00
	Large Bushing *			0,25										0,25	0,25	100,00
	Total	**1,00**	**60,00**	**85,25**	**32,00**									**178,25**	**218,80**	**81,47**
Fruit bowl (8)	**Sweet Melon ***							0,20						0,20	0,20	100,00
	Total							**0,20**						**0,20**	**1,75**	**11,43**
Oilseed (5)	**White Sesame ****		0,10											0,10	0,45	22,22
	Black Sesame		0,10											0,10	4,25	2,35
	Total		**0,20**											**0,20**	6,65	**3,01**
Tubers (3)	**Jerimum Caboclo ****					0,05								0,05	1,35	3,70
	Total					**0,05**								**0,05**	**3,85**	**1,30**
Stock	**Grand total**	**475,90**	**442,20**	**210,25**	**102,00**	**73,20**	**70,50**	**59,61**	**53,50**	**49,50**	**48,00**	**38,75**	**15,50**	**1.638,91**	**9.076,57**	**18,06**

Caption: Stock Classification: High;; Good; Regular; Low; Critical

*** variety with critical stock in the Territory identified only in Queimadas; ** varieties with critical stock in the Territory, identified in Queimadas and another municipality.**

The analysis of the BSC monitoring results allows the BSC Network Seeds Committee to identify the BSC that require funding from Banco Mãe for the cultivation of fields, anticipating actions to ensure the viability of the plantations.

Multiplication fields constitute one of the main strategies for biodiversity conservation, for this reason they will be further detailed in this work. This multiplication can be carried out internally, that is, in the bank itself or externally, when cultivation takes place in controlled environments, called salvation multiplication fields.

Internal multiplication can be carried out when the stock of a variety is critical (EC ≤ 2.00 kg) in the BSC, but is not characterized as critical in the Rede stock (Território da Borborema. In this case, managers and/or associates use their techniques to carry out the multiplication of this variety in the bank or in a member's agroecosystem, even if the ideal conditions for multiplication do not exist, because if the cultivation is not productive, reaching the point of losing what was planted, the BSC will be able to rescue the variety in another BSC from the municipality or another municipality in the Borborema Territory Network.

External (salvation) multiplication occurs when a variety is at risk of extinction in the Territory's BSC Network, that is, it is classified as critical (EC ≤ 2.00 kg) in the Territory as a whole, not just in a BSC or municipality. In this case, to avoid the loss of diversity, the BSC Network must carry out a rescue multiplication field in a location that has support to guarantee the multiplication of the critical variety(s), in particular, an irrigation system. After multiplication, small quantities (0.15 kg) of the multiplied variety will be distributed to the BSC, which must carry out internal multiplication of the variety.

Analyzing Table 5, we identified that in the BSC of the municipality of Queimadas there are 12 varieties with critical stock in the Territory, of which 9 (1 starter bean, 2 macassar beans, 4 broad beans, 1 forage and 1 fruit) present only in Queimadas, that is, its stock is equal to or less than 2.00kg in the BSC Network, making it necessary and urgent to carry out external multiplication fields (salvation) that must be organized by the Territory's BSC Network to avoid the loss of this variety. They are: pork tripe starter beans (2.00kg, BSC2), uranium macassar beans (2.00kg, BSC2), canapé macassar beans (1.60kg, BSC1), bahia beans (2.00kg, BSC1), broad beans laundress (2.00kg, BSC8), broad bean (2.00kg, BSC4), lady's finger bean (1.00kg, BSC9), large loofah forage (0.25 kg, BSC3) and sweet melon (0.20 kg, BSC7), with priority given to the species used in the fields, that is, the varieties of starter beans, macassar beans and broad beans. In addition to these, three varieties with critical stock in the Territory were identified in Queimadas, although the municipality is not the only municipality to have this variety, they are forage black sunflower with critical stock (2.00 kg) in the Territory, it was identified in BSC1 (1.00 kg); the white sesame oilseed with a stock of 0.45 kg in the Territory, of which 0.10 kg in BSC2 in Queimadas and the tuber gerimum caboclo, with 1.35 kg in the Territory, of which 0.10 kg in BSC5 in Queimadas.

On the other hand, it can be identified that some varieties with critical stock in Queimadas are present in the BSC of other municipalities in the territory with “non-critical” stock, making it not necessary to carry out external multiplication fields (salvation). Faveta starter beans are in this situation, as in Queimadas there are 2.00kg (critical stock) and, in the territory there are 184.50kg, classified as good stock. The same occurs with the pink starter beans whose stock in Queimadas is 0.5 kg, however in the Territory the stock of this variety is 72 kg (regular stock). Other varieties are in critical stock in BSC, but the variety does not have critical stock in either the municipality or the Territory. These varieties do not present a risk of genetic erosion in the Territory's BSC Network and, therefore, members of the respective BSC will be able to decide on the need and priority for carrying out internal multiplication fields, checking whether the variety is adapted to the microclimate and soil conditions. the location of the community where the BSC is located.

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REFERENCES

ALBUQUERQUE, T. S.; SILVA, E. D.; ANTUNES, I. F Monitoramento do Avanço da Contaminação dos Transgênicos no Território da Borborema estado da Paraíba. **Cadernos de Agroecologia**, 2020

ALVES, S. A.; MARQUES, G. P.; MENDONÇA, M. R. A Produção de Sementes de Variedades Crioulas e a Construção da Autonomia Camponesa no Movimento Camponês Popular – Mcp – No Brasil. V. 53, N. 9, P. 1689–1699, 2011.

CENSO AGROPECUÁRIO. Rio de Janeiro: IBGE, 2010. Disponível em: <www.ibge.gov.br>.

CENSO DEMOGRÁFICO. Rio de Janeiro: IBGE, 2010. Disponível em: <www.ibge.gov.br>.

COHEN, W. J.. Community Ergonomics And Quality Work Design In The 21st Century. In **Proceedings Of The Human Factors And Ergonomics Society Annual Meeting**. San Diego-USA: IEA, 2000.

COHEN, W. J.; SMITH, J. H.. Community ergonomics: planning and design solutions for urban poverty. In **International Encyclopedia of Ergonomics and Human Factors**. Edited by Waldemar KKarwowski. Vol III. USA and Canada: Taylor and Francis, 2001. p. 1655-1658.

DANIELLOU, F. **A ergonomia em busca de seus princípios: debates epistemológicos**. São Paulo: Edgard Blucher, 2004. 244 p.

Derjani-Bayeh, A.; Smith, M. J.. Application Of Community Ergonomics Theory To International Corporations. In **Proceedings Of The Human Factors And Ergonomics Society Annual Meeting.** San Diego-USA: IEA, 2000.

DULLOO, M. E.; HUNTER, D.; BORELLI, T. Ex situ and in situ conservation of agricultural biodiversity: Major Advances And Research Needs. **Notulae Botanicae Horti Agrobotanici** Cluj-Napoca, V. 38, N. 2, P. 123–135, 2010.

ELLIS, R. H.; ROBERTS, E. H. Improved Equations For The Prediction Of Seed Longevity. V. 45, N. 1, P. 13–30, 1980.

GARBIN, L. C. **Banco de germoplasma de espécies com potencial crioulo: estratégia de conservação de agrobiodiversidade do assentamento 08 de junho, município de laranjeiras do Sul - PR**. Trabalho de conclusão de Curso de Agronomia. UFFS. 2013.

HENDRICK HW, KLEINER BM (2006) **Macroergonomia: uma introdução aos projetos de sistemas de trabalho.** Virtual Científica, Rio de Janeiro

LONDRES, Flávia. (2014). Sementes da diversidade: a identidade e o futuro da agricultura familiar. **Revista Agriculturas: experiências em agroecologia** v.11, n.1. Rio de Janeiro. p.04-08. http://aspta.org.br/wp-content/uploads/2014/05/Agriculturas_V11N1.pdf

PELWING, A. B.; FRANK, L. B.; DE BARROS, I. I. B. Sementes Crioulas: O Estado da Arte no Rio Grande do Sul. **Revista de economia e sociologia rural**, V. 46, N. 2, P. 391–420, 2008.

PETERSEN, P.; SILVEIRA, L.; DIAS, E.; CURADO, F.; SANTOS, A. Sementes ou Grãos? Lutas Para Desconstrução De Uma Falsa Dicotomia. In **Revista Agriculturas: Experiências Em Agroecologia,** V.10, N.1. Rio De Janeiro: As-Pta, Julho De 2013. P. 36-46.

PINHEIRO, S.; NASR, N. Y.; LUZ, D. **A Agricultura Ecológica e a Máfia dos Agrotóxicos no Brasil**. Porto Alegre: Edição Dos Autores, 2000. 356 P.

Plano Territorial de Desenvolvimento Rural Sustentável – **PTDRS Território Da Borborema – PB; 2010- Resumo Executivo 2010 – 2020**. Ministério de Estado do Desenvolvimento Agrário. Disponível em: sit.mda.gov.br/download/ptdrs/ptdrs_qua_territorio024.pdf.

SALDANHA MCW (2004) **Ergonomia de concepção de uma plataforma Line Oriented Flight Training (LOFT) em uma companhia aérea brasileira: a relevância do processo de construção social de projeto**. 236f. Tese Doutorado em Engenharia de Produção. COPPE/UFRJ.

SALDANHA, M. C. W. ; SANTOS, T. S. ; SILVA, E. D. ; **Sistema de Monitoramento de BSC do Território da Borborema.** Paraíba: UFPB. 2017.

SALDANHA, M. C. W. (2017) **Monitoramento da agrobiodiversidade de espécies e variedades de sementes crioulas na Rede de Bancos de Sementes do Território da Borborema-PB**. Projeto de Pesquisa e Extensão. UFPB.

SANTOS, T. da S.. **Sistema de monitoramento de bancos de sementes comunitários como uma ferramenta de gestão para conservação da biodiversidade: estudo de caso no município Queimadas-PB.** 95 p. Trabalho de Conclusão de Curso de Engenharia de Produção. UFPB.2021.

SCHMITZ, W. Driving Macroergonomics Home: A Community Ergonomics Conceptualization. 2000.

SERRA, L. Si. et al. Revolução Verde : Reflexões Acerca da Questão dos Agrotóxicos. V. 1, P. 2–25, 2016.

SILVA, I. L. et al. Banco De Sementes Comunitário Chico Mendes – O Resgate Da Biodiversidade Em Propriedades Familiares Vinculadas Ao Projeto Esperança / Cooesperança. V. 4, N. 2, P. 3043–3046, 2009.

TRINDADE, C. C. Sementes Crioulas e Transgênicos, uma Reflexão sobre sua Relação com as Comunidades Tradicionais. **CREOLE**. p. 1–15, 2007.

UNCED. **Convention on Biological Diversity. United Nations Conference on Environment and Developmen**t, Geneva, 1992.

VIDAL MCR (2003) **Guia para Análise Ergonômica do Trabalho (AET) na Empresa**. Editora EVC, Rio de Janeiro

WISNER A (1987) **Por dentro do trabalho: Ergonomia, método e técnica**. FTD/Oboré, São Paulo