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The Impact of Social Innovation: Benefits for the Rural Area of Varzedo, Bahia

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***Abstract*—** *Innovation is related to the creation of new products, services, or the improvement of existing ones. Social Innovation (SI) concerns an intervention that seeks a new solution to a social problem, creating values for the assisted community, integrating people in the search for a result that satisfies those, directly and indirectly, involved in achieving the generated product, in addition, to establish inter-organizational and personal cooperation between activities and the creation of social innovation. This article aims to identify and analyze the effects of SI developed and directed to the rural population of Varzedo, Bahia. The methodology used was exploratory, descriptive, case study, and field research. Initially, a bibliographic review was carried out on the subject, with legislative and jurisprudential consultation, theses, and articles on specialized websites. Subsequently, visits were made to the rural region of the city, where the local way of life, its actors, and difficulties were witnessed. The results show that the radical and frugal SIs led to sustainable development and social change, generating employment, fixing the man in the countryside, and meeting the aspirations of the assisted population.*

I. INTRODUCTION

Rural development has occurred since the beginning of humanity's experience in social communities, with the change of paradigms, the introduction of new actors with different values, skills, and competencies, in addition to the arrival of progress and innovations, mainly new technologies, resulting in the change of thinking and exploring assets that are available locally [1, 2].

Public policy is an instrument of the State that aims to provide and promote the well-being of the population and may be the result of the articulation of public or private entities with the consent of the public entity. It is usually accompanied by factors, issues, and interest groups and its outcome can be restricted to a specific target group after its implementation [2, 3].

The world and society are undergoing changes arising from the awareness of the problems that are occurring in the world, especially with the introduction of new technologies and climate change, and these factors are influencing the daily lives of people and organizations.

Technological innovation has among its objectives to generate well-being and solve the problems that afflict the world. Its development took place in parallel with the Industrial Revolution when there were great discoveries and inventions to meet the demand of industrial growth [4]. The concept of innovation is related to economic and technological development, relating to products and processes. In the field of social sciences, its study is related to the effects and processes inherent to its application.

Social Innovation (SI) can be interpreted as a relationship of social actors who seek a new effective, efficient, and sustainable solution, capable of meeting a social problem, creating values that are accumulated by society, which differentiates it from routine solutions, where the value created is accumulated by private individuals [1, 2, 5, 6]. Its adoption aims to improve not only the economic logic but also the ability to generate socio-territorial development and improve social capital [1].

The SI is very relevant for the development of rural areas, as there must be integration between the main actors, especially civil society, which must organize itself to make the necessary connections to solve problems and take advantage of the opportunities that are offered. IS requests have increased over time and have been widespread in rural areas. The term innovation generates many questions and understandings and its interpretation depend on the theory used [1, 6].

One of the ways to innovate is through the creation of new products or production processes (radical), or even the improvement of the existing ones (incremental), however, their introduction in the market must be carried out by a company and not by the individual, therefore, the company has relevance in the process. as a gateway to innovation. Another relevant aspect is that innovation does not need to be entirely original, but can be an incremental line, with the ability to improve and improve technologies and products already on the market [1, 7, 8].

Radical innovation requires unconventional thinking, in which the inventor can think “outside the box” or the conventional, requiring a high degree of knowledge, developed skills, with possibilities to open new perspectives and become a vector of innovation. allocation of resources, in addition to playing the role of promoter of change [1,9, 10]. The environments must be suitable to favor creation, with structures open to change, willing to take calculated risks, and experiment with new ideas. On the other hand, incremental innovation aims to modify what already exists, improving it or making new uses [1, 10]

In the scope of the small rural producer, the SI is perceived when technologies and frugality are verified, where the products or services are simple and the solutions are cheap and functional, contemplating a wide range of individuals who are part of the territory, especially the humblest. and without financial resources, where the results aim to circumvent the complex socioeconomic contexts and solve problems related to the low quality of public services or the absence of public policies aimed at the poorest strata.

The term “frugal innovation” is a new concept that emerged in the markets of India and China, characterized by simplicity and clarity in the use of resources. It is about creative improvisation to develop solutions to serve clients with limited resources and generally to serve emerging low-income markets [11]

Varzedo is a municipality in the state of Bahia and is located close to the most populous and geographically larger cities such as Santo Antônio de Jesus, Castro Alves, Valença, Amargosa, among others [12]. A significant part of its economy is fostered by small rural workers and peasants who are part of family farming, who have scarce financial and technological resources to leverage their production. Thus, due to the advancement of SI on rural properties, situations of engagement, and social mobilization of the community, the municipality believes that it is better observed from the perspective of social technologies.

This work intends to identify and analyze the SIs of the rural area of the city of Varzedo. In this context, the objective of the present work arises, which is justified in the face of the contemporary need for the debate on rural SIs, which fundamentally support this portion of the population, enhancing and valuing knowledge in these locations, providing opportunities for growth, access to goods and services. , preservation of the environment and generation of social peace, elements that come into synergy with the Sustainable Development Goals defended by the UN 2030 Agenda [13].

II. METHODOLOGY

The methodology used was exploratory, descriptive, case study, and field research. The literature review addressed issues related to innovation and its particularities. A bibliographic review was carried out on the subject, legislative and jurisprudential consultation,

analysis of books, articles, dissertations, theses, and materials on specialized and institutional websites through research search tools. Exploratory research was carried out to obtain familiarity with the topics studied, helping to improve ideas, to obtain a better understanding of the various aspects related to innovation. [14, 15].

For data collection, bibliographic research was carried out using scientific articles, theses, dissertations, essays, and specialized websites on the subject and with the help of material already published in scientific events, in magazines, newspapers, books, among others.

The need for visits to places and actors in the region was planned and identified, with possible follow-up by specialist technicians working in the municipality, a stage that was carried out in the second phase, through previously scheduled technical visits and initial contacts to survey the region. on the occurrences of Social Technologies (ST) in rural areas, which would contribute to the achievement of answers about the proposed objectives. This initial data collection served for later verification and comparison of probable elements that characterize possible social innovations in the region.

The third stage consisted of the effective survey of the SIs in the rural area through local visits, study evaluations, verification of the TS and their frugalities, as well as the creation of a photographic archive on the observed innovations.

After the third stage, studies and research were carried out on the region and the points addressed in the mentioned incursions. Thus, further visits were scheduled to provide further observations at the selected sites. In the visit that took place on September 15, 2020, with the support of the current director of Agriculture and Environment of the Municipality of Varzedo - Bahia, Sanitary and Environmental Engineer Diego Barreto de Almeida, the following places were visited: Barragem do Braga, Granja Três Brothers and an experimental model farm of cocoa plantation.

Subsequently, a meeting was held with the architect and urban planner Lorena Lago Santana Bittencourt, who presented other particularities about the city, its population, and the role of rural people. In the next step, a visit was made to a unit of the Avigram company, where it was possible to establish contact and clarify doubts about the operation, strategies, and values of the mentioned company and its management body.

III. THEORETICAL FOUNDATION

3.1 INNOVATION

Innovation can be related to the way a new product is introduced, the entry into a new market, a new production process, or a new source of materials. In the Oslo Manual there is the following definition:

Innovation is more than a new idea or an invention. An innovation requires implementation, either by being put to active use or made available for use by other parties, companies, individuals, or organizations. The economic and social impacts of inventions and ideas depend on the diffusion and absorption of related innovations. Furthermore, innovation is a dynamic and widespread activity that occurs in all sectors of an economy; is not the sole prerogative of the business sector [16].

In the Middle Ages, the term innovation was related to new forms or techniques of developing the most varied activities: artistic, as in the Italian Renaissance of the 15th and 16th centuries; industrial, as in the industrial revolution of England and Germany of the 18th and 19th centuries; or, technoscientific, as in the United States of the 20th century [17].

Innovation is present in society today, in all areas and segments. Many confuse innovation with new ideas, beautiful conceptions, and theories of what to do or how something should be. Usually, the change itself, the construction of the new, is not associated. Innovation is more than the idea, it is an idea applied, executed. Processes, products, society, the world transformed, improved, recreated [17, 18].

The innovation process is associated with the progress and development of nations, playing an important role in their future. The more innovative a nation, the greater its prominence in the world sphere. The ability to create, innovate and generate change is a differential, and countries that have scientific talents and exponents occupy a more privileged position when compared to other countries that do not have this condition. Currently, the most used model to explain this movement is the Triple Helix (Etzkowitz), which works with the synergy between government, industry and universities, in addition to being directed towards the same objective. Some more recent proposals point to the need to contemplate a fourth helix, which would be composed of society itself or people [17, 18].

3.2 SOCIAL INNOVATION - SI

Conventional technology does not always solve the demands required by society, as they seek to maximize profit, while Social Innovation (SI) tends to solve a problem that does not always translate into financial gains.

The SI is a new strand of socioeconomic actions with the ability to change the way of life of a significant portion of the population. In society, this term is still not consolidated and operational, despite being worked on for a long time and several authors have focused on it [1, 8, 18. 19].

Some particularities distinguish social innovation from radical and incremental as can be seen in Table 1.

Table 1 - Distinction between social innovation versus incremental and radical

Business innovation	Radical	Incremental	Social innovation
Market needs	New	Existing	Community needs (and opportunities)
Technological trajectory	Breaking	Consistent	Development trajectory
Knowledge	Transformed	Reinforced	Knowledge and skills
Adoption time	Long	Short	Adoption time
Strategy	Stochastic	Structured	Strategy and planning
Risk	High	Low	(Social) Risk

Source: [1]

Table 1 shows that radical and incremental innovation meets the needs of the market, while social innovation meets the needs of a community and not for profit.

The SI has gained prominence over time, mainly to face social, political, economic, and environmental challenges, becoming a strategy for government officials and for raising awareness among the population. Paradigm changes are taking place, where sustainable production is the most important factor, especially with social changes, their demands, and challenges, which require responses that are not always achieved with the use of traditional ways.

Table 2 shows the different definitions of IS over time.

Table 2 - Definitions of Social Innovation

Source	Definition
Fairweather (1967 apud Horta, 2013)	Social innovation means generating alternative solutions to social problems with minimal disruption of order.
Mumford (2002)	Refers to the generation and implementation of new ideas about social relationships and social organizations to achieve one or more common goals and may involve the creation of new types of social institutions, the formation of new ideas about government, or the development of new social movements.
Murray, Caulier-Grace e Mulgan (2010)	Social innovations are defined as new ideas (products, services, and models) that simultaneously meet social needs and create new social relationships or collaborations. In other words, they are innovations that are good for society and increase its ability to act.
OECD (2010)	Social innovation implies conceptual, process, or product change, organizational change, and changes in funding, and can deal with new relationships with stakeholders and territories.
Young (2011)	Social innovation is a new mechanism that increases the well-being of individuals who adopt it compared to the status quo.
Bignetti (2011)	Social innovation is defined as the result of knowledge applied to social needs through the participation and cooperation of all the actors involved, generating new and lasting solutions for social groups, communities, or society in general.
Cajaiba-Santana (2014)	They are new practices created from collective, intentional, and purpose-driven actions, designed to bring about social change through the reconfiguration of how social goals are achieved.
CRISIS (2017)	New social, organizational, or institutional arrangements or new products or services that have an explicit social goal, resulting (voluntarily or not) from an individual initiative or a group of individuals, to respond to an aspiration, meet a need, offer a solution to a problem, or seize an opportunity for action to change social relationships, transform a framework or propose new cultural orientations.
Center for Social	It is a new solution to a social problem that is more effective, efficient,

Innovation – Stanford University (FILÉTI, 2019)	sustainable than current solutions and for which the value created is primarily for society rather than private individuals.
Castro-Arce e Vanclay (2020)	Social innovation can be defined as the creation, renewal, or transformation of social relationships in the development of new ways of working together to achieve social goals.

Source: Taken from [20]

Table 2 shows that there is a diversity of definitions, but all of them recognize that they aim at improving the social system.

The SI must spread among the next, to allow many to get involved and enjoy its results. It is known that there is a significant portion of the rural population is unable to carry out their work activities, depending on benefits or state assistance to survive and the SI represent an important tool to change this scenario [1, 8, 18, 19, 21].

There is a multitude of socio-economic problems in rural areas that can be solved through an SI, constituting an opportunity or need that will negatively or positively impact this event. For each problem, there can be a set of solutions to the needs that civil society urges and that generate specific demands, using abundant human capital as an asset, contributing to enhance rural development and, simultaneously, meet the expectations of the people assisted [1, 8, 19]. The emergence of SI aims to solve a specific social problem, bringing sustainable and effectively applicable solutions. In this way, SI establishes itself as an instrument of change, through an innovative and frugal aspect in the life of each individual, community, and/or nation, with values of transparency, sustainability, social responsibility, and environmental protection.

The SI reflected in its various possibilities of technologies, does not impose itself vertically, as there is a need for popular participation in the elaboration and choice of important points, to value local specificities, reflected in their customs, culture, and desires. Some SI practices are reflections of the critical mass, which has the power to induce its will through convincing narratives, resulting in the reconfiguration of social relations. SI social relationships have three configurations: networks (who); attitudes (why); and, governance arrangements (how). When there is a big change in a configuration, its reflection usually affects the others and tends to cause changes, being able to change its configuration with the designation of new roles and/or new actors in its structure [1, 8, 18, 19].

Network components play key roles, some of which are characterized as innovators, promoters, or followers. Each of them has an attitude according to the degree of the problem, taking into account their values or beliefs and/or motivations, which can influence decision-making, and are influenced by social norms, community history, and formal institutions. Governance arrangements vary according to common interests and new forms of organization, and coordination varies when the heart of the matter is complex and structures are unclear [1, 8, 19, 22]

The application of SI in rural areas has gained prominence in recent decades, mainly because the structures and policies traditionally adopted do not satisfactorily respond to issues such as illiteracy, social inequality, unemployment, crime, poverty, misery, climate issues, education, and economic inequality.

3.3 SOCIAL TECHNOLOGY (ST)

The term technology is derived from the Greek being etymologically composed of two words, the first being technique, derived from tekhne, which means "art, technique, craft". The second is logia, derived from the word logos, which means "study of something". It studies technical and scientific knowledge in several areas of research [4].

Social Technology (ST) promotes several improvements aimed at solving some types of social problems, in its broad fields of action such as education, citizenship, inclusion, accessibility, sustainability, participation, and culture, to promote changes according to with its adaptability to the problem [18, 23, 24]. It is not a product available off the shelf and ready for use, but a dynamic methodology that is adaptable to each reality and field of application, based on popular knowledge and application to local problems to solve needs and pending issues.

ST has some characteristics of its own: it brings news to the localities involved; they represent life improvements and new possibilities for solving existing problems with those involved; and, feeds the emergence of new knowledge, which will effectively bring changes to the existing context. In addition, they do not have a defined temporality, that is, there is no deadline to end, and they bring the possibility of improvement. In essence, they present the willingness to share an economically viable way out for a given point presented, without spatial and temporal stiffening for their emergence and permanence in the face of conflict resolution [19, 25, 26].

The ST must be adapted to smaller scales, with the capacity to release physical, financial, and creative potential, without discrimination between employer and employee, oriented to the internal market, and capable of economically viable small businesses and self-managed enterprises. For its implementation, an institutional culture that is favorable and coherent with the SI is necessary. This culture, instead of criticizing the current model, should prioritize research and the training of human resources, in addition to the solidarity economy and projects led by different social niches [19].

The technology currently used by society is Conventional Technology (CT), described as labor-saving, productivity maximizing, intensive in inputs, with ever-increasing production scales, with coercive controls harmful to productivity, and dependent on environmentally unsustainable machines. In this way, a scenario is established in which production is monopolized by large companies from the most developed countries, not allowing the control of the local producer nor the use of its capacity, configuring itself in an alienating and non-stimulating environment [19].

3.4 FRUGAL INNOVATION

The term frugal innovation first appeared in an article by Zeschky, Widenmayer, and Gassmann (2011). Frugal innovation consists of an innovation that makes the product or service simpler and cheaper, aiming to increase the possibility of acquisition by the poorest strata. Its central objective is to apply extreme restrictions on financial, material and institutional resources in the development of innovations, to achieve a product that has simplicity, limited application, low cost and provides access to the product or service to the greatest possible number of people. Complexity and sophistication are useless if there is no accessibility [11, 27].

There are several studies related to frugal innovation and in Table 3 some are listed.

Table 3 - Definitions of frugal innovation

Author	Definition	Feature
Bhatti (2012)	"It is not simply about reducing costs, but it can also involve increasing buyer affordability through income generation, savings, or alternative payment schemes. Frugal innovation can also mean that the result involves building local entrepreneurship, empowerment and self-reliance or sustainability" (BHATTI, 2012, p. 18).	- Increased accessibility. - Sustainability
Tiwari e Herstatt (2012)	"It seeks to minimize the use of material and financial resources in the entire value chain (development, manufacturing, distribution, consumption, and disposal) to reduce the cost of ownership, meeting or even exceeding certain pre-defined criteria of quality standards. acceptable values" (TIWARI and HERSTATT, 2012, p. 98	- Accessibility; - Robustness; - Conviviality; - Scalability; - Attractive Value Proposition
Bound e Thorthon (2012)	It is a distinct approach to innovation, which responds to the limitations of financial, material, or institutional resources and transforms these restrictions into advantages. It goes against the mindset that frugal innovation can be equated with creating cheap, low-tech products.	Four features: 1) it implies doing better things, not just cheaper things; 2) extends to services and not just products; 3) refers to remodeling not just the disadvantage; 4) Low cost does not mean low technology.
Zeschky, Winterhalter e Gassmann (2014)	"[...] frugal innovations are not restructured solutions, but products or services developed for very specific applications in environments with limited resources" (ZESCHKY, WINTERHALTER, and GASSMANN,	Technical novelty and market innovation. Criteria: even for less, tailored for less and new for less.

	2014, p. 23).	
Simula, Hossain and Halme (2015)	Innovation that meets the needs of low-income customers typically located in low-income emerging markets	- Scarcity of resources; - Simplification; - Environmentally sustainable and lean practices
Weyrauch and Herstatt (2016)	Frugal innovation is characterized by three criteria (both in emerging and developed markets).	- Substantial cost reduction; - Focus on basic functionality - optimized performance level

Fonte: [11]

Table 3 shows that the definitions of frugal innovation are related to low cost, targeting the emerging and developing market, with a focus on adapting products to create consumption opportunities for poor customers. It does not aim at a profit as in conventional innovation, those aimed at/by large companies to increase profit. They are related to all types of problems and social needs, including those under the responsibility of public entities - from basic sanitation, education, health, energy to social development - whose results strengthen society.

Universities and public R&D institutions are favorable places for the development of frugal innovation, as their role is to seek economic and cheap solutions that can be marketed at a lower price, in addition to being a factor in reducing inequality.

3.5 PUBLIC POLICIES

There are several understandings of public policy, with one line focused on government and the other approach emphasizing the role of public policy in solving a problem. Public policies are determined by the State to address a particular public problem. These issues are broad and complex, there is no specific beginning and end to be identified, and they still suffer from multiple interconnections and different causes. These are aspects that hardly find a full resolution, and innovation is the way to balance the theme [28, 29]. Talking about public policies is not simply talking about government policies, because they are not merely statist actions, since the participatory mode is required. In addition, the Brazilian Federal Constitution (CF, 1988) is based on the dignity of the human person.

By not bringing the innovation factor to the essence of public policies and, on the other hand, bureaucratizing the path to the realization of new technologies to the extreme, opens the way for the researcher to consider the feasibility and valuation of their efforts. There is a lack of incentive and appreciation for the search for the new, relativizing the risks and supporting research [3]. In Brazil, the human being is the center of attention and their quality of life will reflect whether the successes are greater than the mistakes. To develop the social is to develop the human [30].

When analyzing the context of the small rural producer, it is observed that this public is not adequately covered within the scope of government public policies, not having easily and constantly available lines of credit to finance inputs for production and other investment needs such as machinery. and equipment. Despite the little support and little recognition of its importance by society, the work of small rural producers is fundamental for the Brazilian population and provides food support to the national economy [31].

On the other hand, without substantial resources, and therefore far from the most modern technological advances, small farmers replicate the knowledge of their ancestors. In this way, they are only sporadically able to evolve in their ways of treating the crop and its products. Therefore, the innovation observed in this context needs to be valued, as it represents the opportunity to propagate improvements, applying the ideals of preservation and sustainable management [32].

Sometimes the custom replicates delayed, unproductive, polluting, and environmentally aggressive actions, which may present an environmental risk or be environmentally reprehensible. Not using pesticides on a large scale, relativizing the use of transgenics, and preserving the environment, among other aspects, raise the quality of the product and value it in front of customers and consumers, who seek natural and consciously produced products. In addition, SIs can play an important role in reducing resource use, costs involved, crop management, and animal production systems. In this way, the implementation of ST can lead to the choice of alternatives with less environmental impact, whether in the production of resources or the destination of garbage and other waste from production [32, 33].

The growing concern with this aspect of agricultural production in Brazil is undeniable, always trying to combine productivity with the safety and quality of the products offered. The 17 Sustainable Development Goals (SDGs) of the United Nations (UN) are tools that exert a certain pressure to achieve goals related mainly to the environment.

Small producers tend to live with greater respect for the environment, with a greater mentality of sustainability and conscious use of natural resources by using traditional processes of cultivation and food production. The population begins to be aware and value products without pesticides and produced in a sustainable way, which has led a portion of small producers to benefit from these results, using methods that prioritize respect for the environment and reduce or stop aggression to nature.

3.6 CITY OF VARZEDO

Varzedo is a municipality belonging to the state of Bahia, with an area of 226.8 km², an estimated population of 8,734 people in 2021 and a population density of 40.16 inhab/km². In terms of population, its position is as follows: 357th among the 417 municipalities in Bahia and 3153rd among the 5,570 Brazilian municipalities [7, 34]. It is 211 km from Salvador and borders the municipalities of Santo Antônio de Jesus, São Miguel das Matas, Castro Alves, Conceição do Almeida and Elísio Medrado. The municipality has the following indexes: IDHM 0.586; GDP of BRL 37,626.444 thousand; GDP per capita of BRL 11,320.10 [7, 34].

The municipality was created in 1989 after its dismemberment from the municipalities of Santo Antônio de Jesus and Castro Alves, consisting of two districts: Varzedo and Taboleiro Castro. In 1933 it appeared as a district of Santo Antônio de Jesus and called Vargem Grande. In 1943 it became known as Varzedo [7, 34].

In 2019, the average monthly income was two minimum wages, and the proportion of employed persons about the total population was only 7.0%. Thus, if you compare the average monthly income of its inhabitants, Varzedo appears well positioned in 89 among 417 Bahian cities, but if the percentage of employed people is analyzed, its performance plummets, going to position 254 among 417 Bahian cities. In the Brazil analysis, it occupies position 2,034 and position 4,507 out of 5,570 respectively. This condition demonstrates the economic and social fragility of the local population. It is observed that households with a monthly income that circulate up to half the minimum wage per person represent 51% of the total number of households in the municipality [7].

The basis of subsistence of the population of the municipality is family farming, therefore, part of its economy is fostered by small rural workers, who do not have access to the necessary resources to leverage their production [35, 36]. In a complementary and ancillary way, there are assistance benefits from the government and the National Institute of Social Security - INSS, such as pensions, income from the Bolsa Família social program, and more recently emergency aid, aimed at minimizing the economic effects that the pandemic caused by Covid-19 has brought to a significant portion of the region's residents

Varzedo exemplifies the topic of IS, frugal technologies, and their likely benefits for those involved, presenting himself as a similar sample of the parameters found in small rural cities in Brazil, presenting a favorable scenario for the development of IS [34]. This is a differential that makes life easier for a portion of the population, bringing new possibilities and opening horizons for the application of ST.

3.7 DAM

According to Resolution No. 143/2012, of the National Water Resources Council (CNRH), a reservoir is an “unnatural accumulation of water, liquid substances or a mixture of liquids and solids”. What usually drives the construction of such a structure is the search for the optimization of the available water resource [37].

A dam is a “[ ] structure in a permanent or temporary course of water for containment or accumulation of liquid substances or mixtures of liquids and solids, comprising the dam and associated structures” [37]. One of the objectives of the dam is to interrupt the flow of a river to form a reservoir, whose stock can be used in the future during the needs of the community [38, 39, 40]. The dams have variable sizes and heights according to their purpose of use. The material for its construction varies, and can be concrete blocks, loose stones, stones in gabion baskets or wood [41].

Small dams, with small volume reservoirs and supplied by run-of-river, most of the time are structures not technically assisted, without operational data records, and usually belonging to the private sphere. Its purpose is to function as a dam, seeking to meet the needs of irrigation and human supply [39, 42].

The climate reality and possible variations in the climate of a region directly affect its water availability and the condition of water storage in small and large reservoirs. Many reservoirs easily lose half of their reserve, which goes back to the conclusion that in the case of small reservoirs, they can only withstand adequately if they operate sustainably [43, 44].

The solutions imposed by the rural communities themselves are most often not based on studies of water availability and deal experimentally with the exploration of water sources and decisions to increase the fulfillment of demands. This is due to the lack of monitoring when analyzing this procedure considering the spatial and temporal variability of the river's water behavior. These

interventions involve a dam for storage and for raising the level and drilling of wells [45].

3.8 BARRET DAM OR MASSAFERRO DAM

In 2012, there was a great drought in the Varzedo region, which led to the construction of the dam in the rural community of Braga, popularly known as the "Massaferro" Dam. It is a structure built by the local population on a water source and which is still responsible for supplying water to the rural areas of Braga, Melado I, and Melado II. The dam is in an elevated region and for this reason, it uses gravity to distribute the water, reaching homes without any type of treatment [45].

It is an enterprise built by the population, without a specific study of capacity and structural basis, having its maintenance, for most of its existence, carried out by the residents of the region. The city hall carried out interventions and inspections on the structure so that it continues to be used by residents and producers in the region, bringing facilities and enabling projects that, without its existence, would be impossible.

The Braga dam was built in 1983 by the Association of Residents of the Braga community, to provide water supply to the communities of Braga, Melado I, and Melado II. Founded by Mr. Angelo Galdino, a member of the Braga community and, at the time, president of the mentioned association. This solution started with a small dam and over the years it was expanded to keep up with the increasing demand for water in the communities, configuring a small dam in stone masonry. The reservoir has an accumulation volume of around 2,814 m3, when it is at its maximum level (Table 1), with a drainage area of 0.5 km² [45].

IV. RESULTS AND DISCUSSION

The SIs identified in the region present solutions for various aspects of society and bring benefits to the assisted community, and in several situations, the results were expressive and will be described below.

4.1 BRAGA DAM OR “MASSAFERRO” DAM

The construction of the dam began in 1983, with the local mobilization of the community to solve the problem of water shortages that affected the residents. The work was done in the form of a joint effort and completed in a few days.

A curiosity about the construction of the dam is that the person who commanded the project was from the community and was unaware of engineering techniques, he only enforced the initial guidelines suggested by his brother. In the initial project, a hydraulic pipeline was installed that connects the dam to the neighboring communities, serving a significant number of people, equipment that today has been enhanced by the local government.

The Braga Dam could serve 222 residential units in the three communities, with per capita consumption of 0.13 m³/inhab.day, an average of 4.96 people per household, equivalent to 144 m³/day. For irrigation, the estimated consumption for properties with 20 ha was 0.6 L/s/ha. In terms of livestock and animal husbandry, the estimated consumption was 0.05 m³/day for 2,000 heads of cattle and 0.0002 m³/day for 70,000 birds, with a total consumption of 1,036 m³/day [45].

Over time, some politicians in the region thought about expanding the dam to increase the water reserve. They partially dismantled the dam, regularly building another, however, the new structure assembled did not withstand the pressure of the water, partially breaking, depleting the community, and generating a general feeling of apprehension. To solve the problem, the community got together and worked on its repair, again using the “massaferro” alloy and traditional knowledge. In this way, the dam is considered a hybrid, as it has part of the construction in the normal molds and partly maintained with “massaferro”, which was the traditional technique used.

The structure of the hydraulic network supplies the communities involved in the Dam project. The supply lines that leave the reservoir of Barragem do Braga, follow through a PVC pipe, which was dimensioned and built by the community, interconnecting with the residences of the locations of Braga (networks 1 and 3), Melado I (network 2), and Melado II (network 3). When there are problems related to supply, such as leakage or clogging, residents gather to carry out maintenance.

During the on-site visit to the Braga Dam, some people were contacted who helped the creator of the structure's construction project. They explained that they used a mixture of 90% clay, 10% cement, and local stones, making the project financially viable and helping to alleviate the serious water problem in the region. The red clay from the Serra da Jibóia was used as a base material, mixing it with the cement using footsteps, which was the traditional way of making the mass for civil construction, until reaching the necessary alloy to be used in the dam construction. Later, they joined this mixture with the stones of the region and assembled the structure of the dam. This mixture was named “massaferro” because of its resistance characteristics. Another important characteristic of the compost created by the mixture is its use in water, as

it does not dissolve easily and, therefore, can be used more widely in the maintenance of the built-up area.

4.2 FARM “BED” CRUSHING MACHINE

During the visit to the farm in the region, significant points of representativeness of TS in operation were detected: equipment for breaking the farm's "bed", chlorine receiver, and heater. Granja Três Irmãos, located in the rural area, specializes in the breeding of poultry for slaughter and directed to the industry Avigran

The poultry litter is the material that is on the floor of the aviary and is intended to serve as a bed, to receive excretions (feces and urine), feathers, skin flakes, and leftover feed from the birds. It is homogeneously cared for, adopting a depth that varies between 8 and 10 cm after compacted. If there is an inadequacy, adverse results will arise and bring problems to the lot that is in the assigned area [46, 47].

When preparing a new batch of birds, the ground is prepared to give comfort to the small animals. With time, the ground is being trampled by birds and keepers, leaving the floor hardened, which harms the creation. Thus, to reduce risks to the health of the animals and increase the productivity of the creation, the "bedding" must be crushed periodically.

The frugal innovation is represented by a rudimentary sewing machine that serves to break the trampled floor of the farms. It uses blades that penetrate the ground and cause a cutting effect.

4.3 CHLORINE RECEPTOR.

Water is an indispensable element for life, in addition to serving for direct human consumption and for raising animals. The healthy use of this resource is of high importance in the production of foods such as those from the poultry industry. Treating water with chlorine is one of the most common ways to regulate this quality [48, 49].

Even though it is fundamental for the survival of animals, sometimes the quantity and especially the quality of water is neglected. Producers are more concerned with feed control than with water. However, between 65% and 75% of the body of birds is represented by water, and this percentage is even higher in the young phase. Water is essential for egg formation, digestion, regulation of body temperature, as well as being an elemental nutrient for survival.

In Brazil, 90% of small rural farmers do not use treated water. In small rural properties, sometimes the water used comes from lakes, rivers, and dams or comes from rain, which is collected and stored in cisterns and wells and used for their consumption, raising animals or for washing and sanitizing places, products, and/or equipment. The risk of contamination of these supply sources or even reservoirs by pollutants, pathogens, or microorganisms is imminent and can lead to serious problems for human or animal health [46, 50]

]. Preserving water quality requires great care with microorganisms, which proliferate in this environment and are invisible to the naked eye.

To avoid risks of water contamination, the most recommended, due to its efficiency and cost, is to use chlorine, which is a legally approved product, has sanitizing functions, and reaches the necessary efficiency as a disinfectant for water, whether for human or animal consumption [50]. In poultry farming, chlorination rids the water of microbes, controlling, above all, the transmission of Salmonella, H1N1, E. Coli, Coccidiosis, in addition to controlling elements that in excess are harmful to birds such as nitrite, iron, and magnesium [46, 51].

To make an efficient dosage for water disinfection, the use of a chlorinator is necessary. On the farm, a component was developed to measure the chlorine used in the treatment of drinking water by the animals. This frugal innovation brings the possibility of using chlorine tablets to control the quality of the water, which is gradually dissolved, keeping it suitable for consumption by the farm for a longer period.

4.4 FARM HEATER

The first two weeks of the chickens' life are decisive for the success in the creation and the occurrence of errors in this period leads to the failure in the results, mainly about feeding, hydration, handling, and ambient temperature. Chicks destined for cutting are poikilothermic animals in their first stage of life, that is, they cannot maintain the ideal body temperature, being extremely vulnerable to temperature changes, since the main organs of the birds and the immune system are formed and develop. in the first seven days of life. Therefore, keeping the environment controlled is essential for the development of birds [46, 52]. Thus, one of the major problems for raising birds for slaughter is controlling the temperature of the environment.

In units lacking technological and financial resources, temperature control becomes the key point for business success. Too much heat or cold can kill animals, leaving smallholders seriously tied to nature's woes. To keep the environment warm in the winter period, some breeders burn wood inside barrels, which somehow control the heat spent on the farm, but do not arrive uniformly. Several burning points are necessary to keep the farm evenly heated, which requires resources to acquire or obtain the wood. Therefore, the issue boils down to distributing the

heat resulting from the burning to the environment evenly in low-temperature periods.

It was at this point that the frugal innovation emerged, which spread to some farms in the region, among them the Três Irmãos Farm. The creation process consisted of the construction of a metallic structure using iron plates and tubes, which, in a completely handmade way, took the form of ovens, where the burning of firewood was better used, saving wood and time. With this technology, better heat distribution is achieved using metallic ducts, which start from a central oven and keep the farm evenly heated, guaranteeing thermal uniformity in a larger space of the farm.

The social innovations identified during the visit carried out in the rural area of the municipality of Varzedo are shown in Table 4 below.

Table 4 - Social Innovations identified in the municipality of Varzedo

Social Innovations	Solution Sought	Results	Current Situation
Braga dam	Provide water for consumption to families in a certain rural region of the city of Varzedo	The objective was achieved and improved, with the creation of several supply lines to other nearby areas.	Following the model created for the Braga Dam, other small structures were set up in nearby regions to supply other locations
Farm "bed" shredder	Provide a loose and aerated soil for the animals	The objective was achieved, because the time of use of the equipment in relation to the traditional way (hand arm) is shorter and brings more efficiency to the handling	Still in full use on several farms
Chlorine regulator	Control the dosage of chlorine applied to the animals' drinking water, to avoid the spread of diseases and financial losses	Substantially reduced farm animal mortality	The technique continues to be used, being endorsed and suggested to other producers
Farm heater	Evenly heat the animal husbandry space	It exceeded expectations, as it provided greater comfort to the animals and increased productivity, in addition to reducing the use of wood, as the heat dissipated by the ducts occurs uniformly throughout the space where the animals are raised.	The innovation continues in use and spreads to other farms in the region

Source: Own authorship (2022)

Table 4 summarizes some of the social innovations visited in the municipality of Varzedo and for their achievement, there was no dependence on particular actions, but the mobilization and participation of society, whose actions were fundamental to generate an improvement for the assisted population, being essential the occurrence of social relationships, structured governance aiming at the event and greater empowerment of the community, where they showed their ability to solve problems that affected the place.

V. CONCLUSION

Communities in need of attention from public entities, such as those identified in this study, show that it is possible to regain self-esteem, restructure places and guarantee better well-being only with the use of frugal innovation and Social Innovations (SI). Despite not having financial and technological support, the population of the municipality of Varzedo showed that with collective work it is possible to achieve positive results that will give them comfort and provide a better quality of life.

The literature review on SI leads to the reflection that they are responsible for an efficient future, with less room for misconduct, forming a participatory sphere and feeding the ability of society itself to produce its answers and solutions, which can contribute to the scope of the SDGs. In the specificities of the technologies involved, many are developed by the peasants themselves, who will use them for their well-being and that of the community in which they live.

SI represents an opportunity that arises with the simplicity of objectivity, bringing answers that solve questions that were difficult to solve until then. The objective is to be able to change and improve the local dynamics, based on concepts of humanization and integration.

SI and frugal innovation have the power to transform rural society, generating sustainable development and, consequently, social change, meeting all the aspirations of the actors involved, where each one has a relevant role in decision-making and in the execution of the work to be done.

The social innovations of the municipality of Varzedo make a difference, strengthening the understanding that even without all the necessary support, the creativity and frugality of the rural worker's actions are decisive for the success and improvement of the product and living conditions.

It is concluded that the SI in the rural sphere of the municipality of Varzedo, Bahia, presents, on the one hand, a consolidated dimension and, on the other hand, ample possibilities of expansion of its concept to be used in the resolution of other social problems that afflict its population, mainly rural residents, who lack the institutional support of public entities in all spheres, whether municipal, state and/or federal

Finally, the SI and the frugalities pointed out and related in this work, bring to light all the social characteristics of an innovation, and highlight the potential of the rural worker, demonstrating the need for greater support from private and public entities through public policies specifically focused on for that segment.

The work was limited to only a few SIs that could be visited, but others can be studied in the future.

The article can be applied in other municipalities, as there is a lack of support from public entities in the rural areas of the municipalities and this condition allows their residents to seek to solve problems in a community way, with the provision of effective and low-cost solutions.

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