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Transform Sustainable: Innovating for a Sustainable Future

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Abstract. The Transform Sustainable Program of the Federal Institute of Education, Science and Technology of the South of Minas Gerais (IFSULDEMINAS) is an example of how creativity and innovation can transform challenges into solutions. Through the transformation of donated and seized materials into high-value products, the program contributes to environmental protection, income generation and social development. The program's main focus is on sustainability, reducing material disposal, promoting reuse and recycling, and contributing to the circular economy. Technological innovation is also fundamental, with the development of innovative solutions to transform discarded materials into high-value products. The program has a partnership with several institutions, such as the Brazilian Federal Revenue Service (RFB), city halls, schools and NGOs, demonstrating the power of collaboration to generate positive social impact. By generating income for local communities, promoting environmental education and social development, the program contributes to building a fairer and more prosperous future for everyone. Transform Sustainable is an inspiring model that demonstrates the potential of sustainability, innovation and collaboration to build a greener, fairer and more prosperous future for all. Through the union of efforts between IFSULDEMINAS and several institutions, the program is transforming the present and building a more sustainable future for the next generations.

Keyword:
Circular Economy, Public Institutions, Sustainability, Partnerships

1. Introduction

1.1. The IFSULDEMINAS

The Federal Institute of Education, Science and Technology of the South of Minas Gerais (IFSULDEMINAS) is a public institution of higher, technical and technological education, which offers courses in various areas of knowledge, both face-to-face and distance learning. The institute is located in the southern region of the state of Minas Gerais, Brazil, and its mission is to promote education, research and extension, aiming at the sustainable

development of the region and the formation of critical and competent citizens [7].

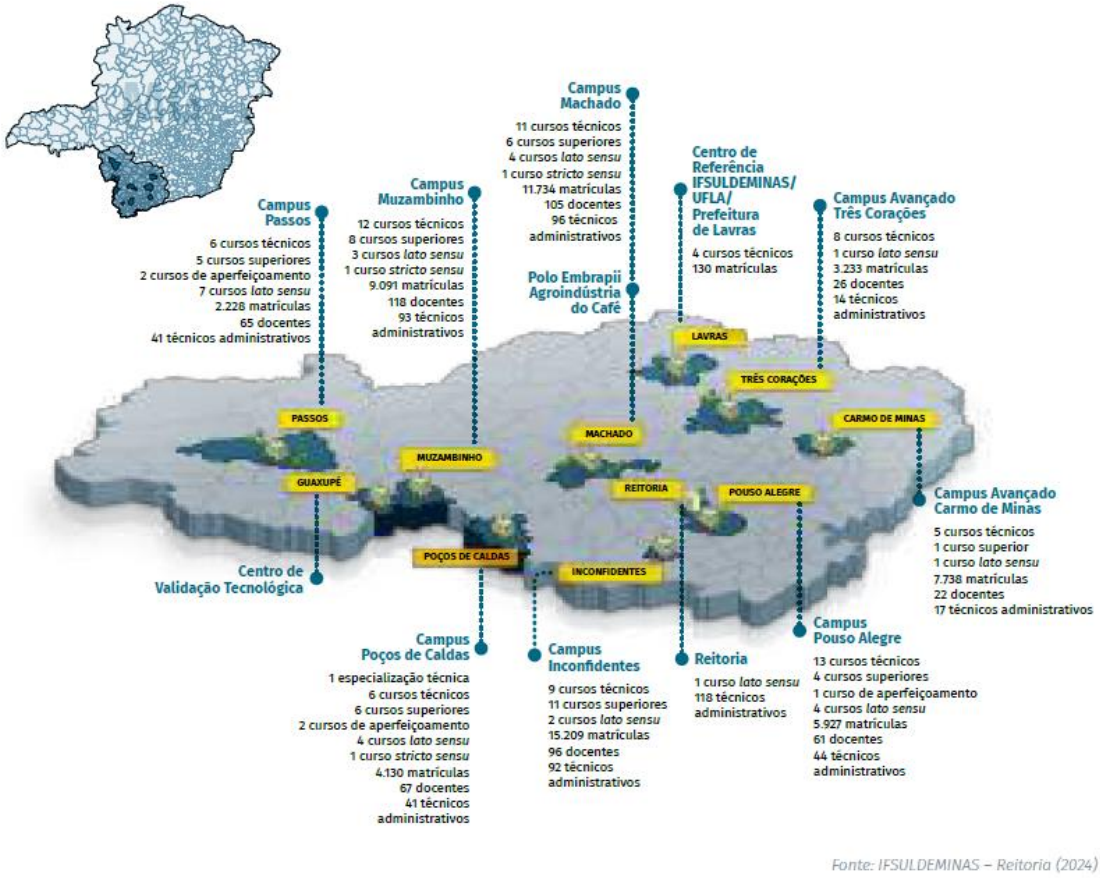

Figure 1: The Federal Institute of Education, Science and Technology of the South of Minas Gerais (IFSULDEMINAS) [7].

IFSULDEMINAS was created in December 2008, from the integration of units from the former Federal Agrotechnical Schools of Inconfidentes, Machado and Muzambinho. Currently, IFSULDEMINAS has eight campuses, located in Inconfidentes, Machado, Muzambinho, Passos, Poços de Caldas, Pouso Alegre, Carmo de Minas and Três Corações, a Reference Center in partnership with the City of Lavras and UFLA, in addition to agreements signed with 63 support centers for Distance Learning (EaD), a Technological Validation Center in Guaxupé and an Embrapii Agroindústria do Café Center in Machado, in addition to the Rectory in Pouso Alegre. In the near future, there will be the implementation of another campus in Itajubá [7].

1.2. The Transform Sustainable Program

The Transform Sustainable Program is the product of an action to mitigate physical, biological and chemical risks, with the improvement of investment in reverse logistics and management of materials that can be used through manufacturing work, technological development and research.

Figure 2. Logo of the Transform Sustainable Program.

The objective of the program is to collect materials that would previously have been destined for expensive and sustainably unviable destruction and disposal; processing these items and using them as raw material, which generates material that can be used in IFSULDEMINAS and also to support prison units, educational and philanthropic institutions throughout the southern region of Minas Gerais.

The program began through a partnership between IFSULDEMINAS and RFB, when during the Coronavirus Pandemic there was a shortage of basic products necessary to combat the virus and promote health around the world. Through tests and research carried out at Campus Inconfidentes, it was discovered that with the supply of the correct inputs, IFSULDEMINAS could produce alcohol. The product could be generated in liquid and gel form, through the processing of inputs through an alcohol rectification tower; material which was essential for the promotion of hospitals, schools, city halls and the general population throughout the South of Minas and the main agent in reducing the spread of the virus throughout the region.

Initially, the necessary alcohol was obtained through the processing of alcoholic beverages, perfumes and fuels, through the rectification process. This input was donated by the RFB after being collected through several seizures over the years. This action allowed the production of around 44 thousand liters of alcohol, through the processing of 190 thousand liters of merchandise seized from smuggling, which generated savings in government resources by avoiding the total destruction of the material, saving the disposal of all the material in the form of garbage to nature and produced the material responsible for reducing the spread of the Coronavirus throughout the South of Minas region.

In a second action, a total of 40 tons of clothing was processed, through partnerships, both internal, such as between the Rectory, Campus Machado, Campus Muzambinho and Campus Passos, and external, such as with the Association for Protection and Assistance to Convicts (APAC) Women's Pouso Alegre. The clothes, caps and bags were organized, classified and sent to work to remove trademarks and patents, so that they could then be returned to the community. This action generated support both for clothing in its natural application and for supplies for crafts, practical classes and courses throughout the region.

There was a great process of innovation through the processing of cigarettes, tobacco and food supplements at the Muzambinho Campus. The work of composting and disposing of inputs and waste correctly enabled the disposal of 45 tons of destroyed tobacco and cigarettes and around 22 tons of human supplementation in the years 2022 and 2023, generating a production of more than 225 tons of organic compost, rich in various nutrients.

The need to dispose of seized wine, which is a product of organic origin and with a low alcohol content, required research and improvement of technologies for use. After analysis and selection through the Food and Bromatology Laboratory at Campus Muzambinho, it was

possible to separate the product suitable for consumption from the unsuitable one. After several researches through the Agroindustrial Production Sector, an edible product was developed, like jelly, suitable for consumption and capable of large-scale production across the campus, which made the input a material capable of being used in cafeterias and commercialized for generation to promote the demands of IFSULDEMINAS.

With the increase in demands for expansion and maintenance of campuses, there was a need to produce furniture. So that we can work with furniture in an economically viable and ecologically sustainable way, the program collects donated material across the country, processes, repairs and returns it for use on the IFSULDEMINAS campuses.

And, finally, following the increase in seizures of electronic equipment intended for clandestine capture of satellite signals for television, popularly known as “TV box”, technology was developed capable of transforming receivers into microcomputers, which are destined for city halls and schools throughout the region, through a public call.

So, as an initial plan, the Transform Sustainable Program worked with six aspects, namely: work with alcohol at Campus Inconfidentes, work with clothing at the Rectory, production of organic compost and jelly at Campus Muzambinho, processing of furniture at the Rectory and production of microcomputers.

2. Theoretical Approach

2.1. The Principle of 5 R’s and Brazilian Legislation

The 5 R's policy is a strategy to reduce the environmental impact related to consumption and waste management. The five R's are: Reduce, Rethink, Reuse, Recycle and Refuse to consume products that generate significant socio-environmental impacts [4].

Figure 3. The Universal Recycling Symbol [9].

This approach goes beyond simple recycling and includes changing habits to reduce overconsumption and waste. Recycling is highlighted as a practice already adopted by industries to replace raw materials with recycled materials, but it is still necessary to expand the market for these products. The benefits of these practices include a reduction in the extraction of natural resources, waste in landfills, public waste costs and energy use [4].

In 2010, Law 12,305 was enacted, which established the National Solid Waste Policy (PNRS) [1]; Finally, in 2022, Decree 10,936, which regulated Law 12,305 [2], and Decree 11,043, which approved the National Solid Waste Plan (Planares) [3, 6], were published.

Planares is a central piece of PNRS, establishing guidelines, strategies, actions and goals to improve waste management in Brazil. The plan includes the ambitious objective of eliminating all landfills and increasing the waste recovery rate to 50% in 20 years, promoting techniques such as recycling, composting, biodigestion and energy recovery. Currently, only 2.2% of urban solid waste is recycled in Brazil. Planares also seeks to increase recycling in

civil construction to 25%, contribute to the generation of green jobs and fulfill international commitments, facilitating Brazil's accession process to the OECD. Waste recovery also aims to reduce energy consumption and greenhouse gas emissions. The preparation of the plan involved consultation and public hearings, ensuring legal certainty and attracting investments in the long term [5].

The National Information System on Solid Waste Management (SINIR+) was also created, a tool established by the PNRS and regulated by Law 12,305/2010. The coordination of SINIR+ is the responsibility of the Federal Government, through the Ministry of the Environment, while the organization and maintenance of the system is shared between municipal, state and Federal District governments. These federative entities are required to provide the federal government with information on waste management in their respective territories annually. SINIR+ supports solid waste management in Brazil by providing a technological platform that includes maps, dashboards and reports. These instruments help in formulating public policies and creating strategies and business opportunities at national, state and municipal levels [5].

2.2. The Relationship between the Sustainable Development Goals (SDGs) and the 5 R's

The principles of the 5 R's (Reduce, Rethink, Reuse, Recycle and Refuse) directly align with several of the Sustainable Development Goals (SDGs) proposed by the United Nations. These SDGs aim to address key global issues, including poverty, inequality, climate change, environmental degradation, peace and justice. Let's relate the 5 R's to some specific SDGs:

- SDG 3 - Health and Well-being: Efficient waste management and pollution reduction also contribute to healthier environments, reducing the negative impacts on human health caused by poorly managed waste and pollution.
- SDG 11 - Sustainable Cities and Communities: The practices of reducing, recycling and reusing contribute to the sustainable management of urban waste, reducing the amount of waste that ends up in landfills and promoting more sustainable urbanization.
- SDG 12 - Responsible Consumption and Production: This objective aims to ensure sustainable consumption and production patterns. The 5 R's promote more conscious and efficient consumption, encouraging the reduction of resource use, reuse and recycling of materials, which is directly aligned with this objective.
- SDG 13 - Action Against Global Climate Change: Reducing consumption and increasing efficiency in the use of resources can significantly reduce the carbon footprint. Recycling and reusing materials also contribute to reducing greenhouse gas emissions.
- SDG 15 - Life on Earth: The 5 R's policy helps to reduce the demand for natural resources, which can reduce pressure on terrestrial ecosystems and biodiversity.
- SDG 17 - Partnerships and Means of Implementation: The implementation of the 5 R's requires collaboration between governments, companies and citizens, reflecting the need for strong partnerships to achieve the SDGs.

By adopting the principles of the 5 R's, societies around the world can make significant progress towards meeting these Sustainable Development Goals, promoting a more sustainable and fair future for all [8].

3. Results, Discussions and Implementation

The beginning of this new stage of work of the Transform Sustainable Program will work with three aspects: production of organic compost and jelly on the Muzambinho Campus,

processing of clothing and furniture in the Rectory and production of alcohol and cleaning products.

The production of organic compost aims to meet the demands of IFSULDEMINAS, in addition to promoting farmer cooperatives in the city of Muzambinho and making it possible to fertilize vegetable gardens in the prison system and APACs in the South of Minas. The jelly production will be divided to meet the needs of IFSULDEMINAS, RFB and partner prisons.

The clothing used will be used exclusively to support prison institutions, APACs and social programs in the region. It will benefit from the labor of prisoners and those recovering, who will receive part of this material and/or grants to pay for their work. This initiative aims to encourage recovering people to behave well, promoting their resocialization and decent work.

The furniture will be allocated and initially worked on in the Rectory. Its production aims to meet internal needs, however, if there is a surplus of material, it must be sent for structuring administrative parts and prison units in the South of Minas. Due to this large amount of material, the Rectory will also provide all logistical support, both for travel and for the supply of materials, so that the Program can function properly throughout the Institution.

3.1. Organic Compost Production

Cigarettes, mainly smuggled from Paraguay and the United Kingdom, are the most seized product in Brazil, with 355 million packs seized from 2010 to 2016. The destruction of these cigarettes, required by Decree No. 9,516/2018 to be environmentally friendly, represents a challenge due to its volume and environmental impact. Between 2019 and 2021, almost 4 million reais were spent on logistics for packaging and destruction alone.

Campus Muzambinho created an ecologically correct disposal method, using composting to transform tobacco from seized cigarettes into organic fertilizer, combined with animal waste and gardening leftovers from its agricultural and zootechnical laboratories. Annually, these laboratories produce 270 m^3 of animal waste and 400 m^3 of gardening waste, which serve as the basis for organic compost. This composting process, enhanced to use 65% tobacco, 5% food supplement and 30% animal waste, results in nutrient-rich material, benefiting the school's crops and local farmers.

Figure 4. Production of organic compost at Campus Muzambinho.

The logistics of the composting program involve collecting organic material from the agricultural campus, tobacco from processed cigarettes in Belo Horizonte and food supplements dispersed throughout the country, with greater complexity in collecting the latter. Transport is carried out mainly by IFSULDEMINAS trucks. Compost production requires a significant staff, including a coordinator to manage inventories and labor, student scholars for analysis and documentation of the material, and workers for handling and processing in the field, including moving and monitoring the compost. Furthermore, itinerant labor, made up mainly of inmates from Pouso Alegre, is used to mischaracterize the food supplement, with the aim of resocializing and advancing the sentences of those involved.

Figure 5. Bagged organic compost for donation.

3.2. Jelly Production

Jelly is a type of fruit jam, made with the liquid resulting from the cooking of fruit mass and/or concentrated juices, having a translucent appearance and a gelatinous consistency, thanks to the pectin in the fruits. In the case of wine, we have a concentrated liquid resulting from the fermentation of grapes. In the fermentation process, grape juice has its sugar transformed into alcohol. To obtain the jelly we have to do the reverse process, where through heating we release the alcohol and part of the water present, concentrating it to the point of mass, adding sugar to emphasize the flavor and pectin to give texture. In this way we have a palatable and tasty sweet that is presented: Wine Jelly.

Figure 6. Wine jelly manufactured by Campus Muzambinho.

The main material collected for production is wine seized due to tax evasion or lack of registration with the Ministry of Agriculture and Livestock. This material is removed from RFB yards and stored in a restricted entry room, always remaining locked and monitored. This wine will be processed by the local campus cooperative, which will account for the amount of packaging used, the total volume used and the amount of final product obtained. Waste generated by production can be sent for reuse on campus, or sent to local recycling cooperatives, depending on the best environmental destination to be determined at the time.

Figure 7. Delivery of wine cargo seized by the RFB.

The local Campus coordinator is responsible for managing the activities of this aspect of the program. He must be advised by a fellow who will control the stocks and production of the program's activities on his campus, and will have managerial autonomy to adapt the formula used for production according to the improvement provided by the various tests carried out. The product will be made through a partnership with the Campus Muzambinho cooperative, which will be responsible for the production, packaging and storage of the product until its final destination.

3.3. Clothing Mischaracterization

The final destination of clothing, footwear, sneakers and bags seized because they were transported without the appropriate tax documents, as well as because they were

counterfeit famous brands, initially occurred through direct destruction. However, when analyzing the parts of the item, we can understand that the counterfeit is characterized by the use of a brand/patent on a non-original product, produced clandestinely with the aim of representing the status of a famous brand, generally imported and priced high.

Figure 8. Clothing mischaracterization by inmates recovering at APAC in Pouso Alegre.

It can then be concluded that the key point in the mischaracterization of clothing is the removal of copies of patented brand logos, as the rest of the material can be reused both for its original purpose and as raw material for various actions. With the analysis of this list of possibilities, the area of processing clothing for use in philanthropic entities, APACs and Prison Units throughout the region was born.

The mischaracterizing seized items, such as shoes, clothes, bags, caps and backpacks, that have counterfeit brands or are involved in tax evasion includes removing logos and other identifying details from brands through techniques such as sanding, abrading, cutting, and even painting over the logos to hide them.

- Footwear: Techniques such as sanding, peeling and cutting are used to eliminate brand symbols, making items suitable for quality checking and final use.
- Clothing: Methods such as cutting around brand designs and painting over logos are applied to de-characterize the pieces, which can then be used in training courses, or recycled into other textile products that become unusable as clothing.
- Bags, hats and backpacks: These items are treated with cutting and pulling tools to effectively remove pins and tags with minimal material loss.

This methodology allows the reuse of seized products in a socially and environmentally responsible manner, contributing to professional training and the reuse of materials.

3.4. Furniture

The work with furniture originated with the demand to dispose of materials that were idle due to maintenance and renovation, a fact present both in IFSULDEMINAS and in several public bodies that today promote our partnership.

To meet this demand, IFSULDEMINAS captures idle materials on its own campuses and in partner institutions, selects what is viable for repair and what can be used as spare parts, carries out the necessary repairs and manages to return the material for use on the campuses.

Figure 9. Donation of mismatched clothes to the city hall and parish of Inconfidentes.

Figure 10. Armchairs donated to IFSULDEMINAS.

Previously, the disposal of these materials was expensive and highly polluting, as the public body does not have adequate methods for disposing of furniture and equipment. With this new material recoverability analysis, most of the material previously classified as unusable could be reformed, which avoids both the expense of disposal and the expense of new acquisitions.

The initial work consists of attracting partnerships to supply materials to promote the program's activities. After establishing a partnership with other federal agencies, the logistics of material collection begin.

Due to the cost generated in collecting and transporting materials, whenever possible, trips are scheduled in order to optimize expenses through multiple collections on the same route.

The search for material takes place by moving a truck, van, or other official vehicle, depending on the volume of material to be transported and logistical availability.

The department has a professional to support administrative activities who has experience in material and vehicle logistics. This professional will be responsible for monitoring possible donations on official websites and managing the logistics necessary to collect materials outside the headquarters.

Figure 11. Furniture donated to IFSULDEMINAS.

To control materials and inputs, the department will have a fellow with warehouse experience, who must maintain control of all stored material and promote the purchasing processes for inputs necessary for the action.

In addition to these, a professional dedicated to activities involving renovation, assembly, painting and adjustment of the material received is necessary. This scholarship holder needs to have basic knowledge about assembling and repairing furniture, in order to be able to organize and make the necessary improvements to the goods received. This workforce can be selected either by notice or by internal selection among convicts in the semi-open APACs prison sentence regime in the region, depending on the availability of professionals with experience in the area.

3.5. Production of Alcohol Gel and Cleaning Material

During the beginning of the Coronavirus Pandemic, there was a global scenario of scarcity of resources to combat the transmission of the virus. The main resource that was exhausted in the first days of the pandemic was declared alcohol, as this would be the main means of hygiene available to avoid contamination of those who could not remain isolated.

To meet this immeasurable demand for material, the technical staff at Campus Inconfidentes set out to develop a way to process raw materials rich in alcohol content and produce alcohol, in liquid and gel form, with sufficient quality for hand disinfection and surfaces.

Figure 12. Manufacture of alcohol gel at Campus Inconfidentes.

The Inconfidentes Campus has one of the only alcohol processing towers belonging to public educational institutions in the country. This equipment was essential for the research

and innovation process on the processing of alcoholic beverages to occur.

Figure 13. Alcohol processing tower at Campus Inconfidentes.

After several tests and tests, using a processing and purification process through the heat obtained by boilers and the pressurization achieved by the equipment, it was possible to purify the mixture resulting from mixed alcoholic drinks, perfumes and fuel alcohol. This process generated liquid alcohol, which when mixed with a substance called carbopol, generated gel alcohol.

Figure 14. Stock of drinks seized by the RFB donated to IFSULDEMINAS.

This product made it possible to promote hospitals in all cities in the south of Minas. Through an IFSULDEMINAS campaign, alcohol was made available in surrounding cities so that the population could collect sufficient quantities for family protection.

After the success of the project and considerable reduction in Coronavirus transmission levels in the region, the original demand for liquid and gel alcohol decreased. This material continues to be produced and sent for use in cleaning and disinfection both internally at IFSULDEMINAS and in registered NGOs and APACs.

In a second phase of the program, there was a new formulation for the production of room odorizers. This material uses alcohol-based raw materials, which makes it an efficient cleaning product intended for disinfection, and has an aromatic base. These aromas can originate from perfumes, normally seized due to illegal imports and tax evasion, or can also

be obtained through aromatic essences normally destined for electronic cigarettes.

Figure 15. IFSULDEMINAS team during distribution of alcohol gel to the population during the Coronavirus Pandemic.

Figure 16. Odorizers produced with the essence of electronic cigarettes seized by the RFB.

Today IFSULDEMINAS is an institution self-sufficient in alcohol for cleaning and alcohol gel, being recognized nationally for its actions on the front line in the fight against Coronavirus.

The mischaracterization of material for the production of alcohol and odorizers involves two main steps. Firstly, the material is divided into that which has a high alcohol content and that which has aromatic qualities. Material with a high alcohol content, such as alcoholic beverages and fuel alcohol, needs to be carefully mischaracterized. The drinks are opened and poured into large containers to lose their consumer identity, a time-consuming process that must be carried out in a safe place due to the risk of flammability.

The fuel alcohol, without specific brands, is stored in barrels for the following stages. The aromatic material is kept separate and sealed to preserve its characteristics until dilution and mixing in the final production process.

Waste, including glass, plastic and cardboard, is sent to recycling cooperatives for environmentally friendly disposal.

The process begins with the preparation of a suitable location for storing material that has not yet been mischaracterized, which needs to be an environment that can be locked

and preferably monitored. In addition to this initial material, it is necessary to ensure the safe storage of the already mischaracterized material and subsequently of the properly processed material, always aiming to ensure the good packaging of flammable material.

It is important to emphasize that the transport of explosive material in vehicles requires specialized and qualified labor, which is why the driver responsible for the movements must have the courses requested by transit agency.

All employees involved in the process of transporting, packaging and processing material need adequate training, aiming at good practices and minimizing the risk of accidents throughout the process.

The alcohol and odorizer production process at IFSULDEMINAS involves a team of four professionals: a coordinator, two equipment operators and a scholarship student. The coordinator is responsible for developing the formulas and the quality of the material, in addition to conducting and reporting the activities to the General Coordination of the Program.

Operators are divided into two functions. The first maintains the appropriate temperature using the boiler and helps with the movement and filling of products. The second supplies and controls the alcohol tower, manages the stock, and supervises the filling and labeling of the material.

The scholarship student supports the production process and is dedicated to research and technological development, recording all scientific production. This student must be enrolled in a related course and have sufficient technical knowledge to produce scientific publications on the topic.

3.6. Logistics Support

Due to the large size of the Program and the large amount of materials received, logistical centralization is essential for the smooth functioning and efficiency of the work. Initially, general logistics will be covered by clothing and furniture, as they are located in the Rectory and have a greater number of trained fellows.

Logistics includes attracting partnerships, contacting suppliers and partner networks, organizing the collection of materials, as well as external and internal transport. The coordination of labor and the use of vehicles will be carried out on an intercampus basis, in order to optimize resources and strengthen institutional ties.

Understanding the need for specific labor to meet specific demands, logistics will also be responsible for maintaining a register of qualified personnel for sporadic work, quantified through hours worked. This registry will include a database of prison labor capable of carrying out activities, which will have priority when distributing low-danger activities.

4. Conclusions and Future Perspectives

The initial objective of the Transform Sustainable Program is to reduce costs and pollution generated by the disposal of material seized in the country, de-characterizing it and transforming it into material capable of being destined for the economically needy population. This new way of forwarding material that would otherwise be destroyed aims both to promote public sector activities and to promote the resocialization of the prisoner, who will work actively on the project.

This first stage will be aimed at the basic structuring of all aspects and the production of pilot products for testing and approval. In this initial period, part of the material produced will be destined for personal consumption at IFSULDEMINAS, and the other part will be sent to philanthropic entities and penitentiaries in the region. Among these entities, we can

highlight the Association of Rural Producers in Muzambinho, which will receive the production of organic compost, the APACs in the region to receive clothing, the prisons of Pouso Alegre and Itajubá to receive hygiene products, in addition to NGOs and OSCs support for needy communities to receive all types of material.

In addition to this material, the furniture produced will be allocated at IFSULDEMINAS itself, serving to meet specific structuring demands. The jelly will be supplied for student consumption, institutional events, the Brazilian Federal Revenue Service and the local cooperative.

In a second stage of the program, which will include greater structuring of machinery and vehicles, the Program intends to supply on a large scale to philanthropic institutions registered in the selection notice and in partner prison units throughout the region.

Throughout the course of the program, the technical-scientific report of the action will be made through tests and productions carried out accompanied by a student from the Institution, who will document and disseminate them in an academic environment, demonstrating the importance of developing the action in the academic field .

Up to half of the Program's execution period, it is expected to directly serve a total of more than 60 thousand students from IFSULDEMINAS, 2 thousand employees from IFSULDEMINAS and the RFB, 1 thousand prisoners from the Itajubá Prison, 800 prisoners from the Pouso Alegre Prison, 80 prisoners from the Santa Rita do Sapucaí Prison, in addition to 250 people recovering from the Pouso Alegre and Varginha APACs. In addition to this audience, it is also expected to reach the families of all beneficiaries, reaching an estimated 250 thousand people throughout the south of Minas Gerais.

At the end of the Program, it is expected to cover the service of all NGOs and City Halls registered in the IFSULDEMINAS notices, reaching an estimate of over 120 thousand people.

Thus, the Transform Sustainable Program aims to reuse seized material that would otherwise be destroyed, using primarily the labor of people under custodial sentences, and reaching a total of 360,000 people throughout the south of Minas Gerais.

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