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FROM WASTE TO SOIL: COMPOSTING AS A SUSTAINABLE STRATEGY FOR ORGANIC WASTE MANAGEMENT

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From Waste to Soil: Composting as a Sustainable Strategy for Organic Waste Management

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Abstract:

Given the current reality of Brazilian agriculture, which relies heavily on the use of pesticides and industrial fertilizers, many areas are now contaminated, harming local life. This article presents a project developed in a Land Reform settlement in Sidrolândia-MS. It discusses the advantages and results of an agroecology-based agricultural system, which generated significant annual income for families in just over two years. The research highlights that a new approach to food production is possible, promoting balance and natural synergy.

Keywords: *agroecology; land reform; sustainable agriculture; income generation; environmental balance.*

1. Introduction

The current situation in Brazilian agriculture is alarming. The use of pesticides, combined with unchecked application of industrial fertilizers, has contaminated the environment for decades. In some areas, entire properties have become desertified. This is a result of the evolving production system throughout human history, particularly post-World War II, which introduced "chemical-mechanical-genetic" transformations without assessing their environmental impact (GUIVANT, 1998). Today, this has led to soil degradation, water contamination, deforestation, and public health issues.

Despite evidence of the dangers of toxic agrochemicals, Brazil lacks a regulatory law prohibiting their use in agriculture. However, there is a growing movement toward a sustainable and healthy agricultural model, particularly in family farming, as noted by Santos (2001). Many family farmers participate in land reform projects supported by the government.

In Brazil, land reform involves utilizing unproductive areas bought by the government for development, which poses challenges for families receiving contaminated, eroded, and deforested land. An alternative is the recovery and detoxification of soil through agroecological techniques.

Implementing agroecology requires careful study and observation of nature, as resources vary across biomes. Agroecology serves as a tool for developing healthy, sustainable agricultural plans. The Brazilian Association of Agroecology (ABA) defines agroecology as a scientific and political movement aiming to create sustainable food systems through a transdisciplinary approach (VIGLIZZO, 2001).

In Sidrolândia, MS, a soil recovery system linked to healthy food production was initiated in September 2014, adapting practices over time. Effective methods yielded a gross income of 15,000 reais in the past year, according to data from AGRAER. This work will detail the establishment of an organic production system based on agroecological practices leading to an agroforestry system (SAF).

Techniques for recovering this degraded environment included homeopathic methods, cover crops, the introduction of effective microorganisms, composting, and green manure, notably Canavalia ensiformis and Crotalaria junceae, which recycle nutrients (SANTORI et al., 2011). After nearly three years of detoxification and soil recovery, the next phase will focus on expanding production with successful methods, such as growing cucurbits and introducing fruit saplings.

2. General Objective

Evaluate an agroecological method in the recovery of degraded environments..

3. Specific Objectives

Encourage observation and study of the environment.
Indicate tools that have proven effective in the process of environmental recovery.
Show the results of agroecological management in family farming.
Highlight the importance of teamwork in agroecological practices.
Apply the concept of syntropic agriculture in practice: “in nature, everything should tend toward balance.

4. Methodology

The work was developed on a rural property in P.A. Nazareth, lot 99, in the municipality of Sidrolândia-MS. For two years, all results were monitored, and management practices were implemented based on evaluations. The plot was photographed throughout the process. Soil samples were collected from the entire lot, and soil analyses were conducted to assess its degradation level, allowing for proper interventions and management. Subsequently, soil management and the recovery method were implemented step by step. Activities

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included mowing the planted grass, soil harrowing, applying homeopathies, planting species resistant to the soil's physical and chemical conditions, green manure planting, introducing efficient microorganisms collected from a local biological reserve, cultivating agricultural varieties, compost production, and growing seedlings of different plant species for system integration, seedling hardening, harvesting, and evaluating the developed method. This activity began in January 2015, and evaluations were conducted in January 2017.

5. Development

5.1 - "Project start: soil and plant evaluation."

The first step taken was the soil collection from the entire rural property, following the required technical standards. The soil was dried and sent for analysis to identify the composition of micro and macronutrients and acidity levels. The soil analysis indicated deficiencies in phosphorus, calcium, magnesium, and zinc, as well as a high index of toxic aluminum, which hinders root development for a wide variety of plants.

The granulometric analysis classified the soil as type 1, which, according to INSTRUCTION NORMATIVE No. 2, dated October 9, 2008, is characterized by sandy texture, with a minimum clay content of 10% and less than 15%, or with a clay content equal to or greater than 15%, where the difference between the percentages of sand and clay is greater than or equal to 50. Thus, adopting the clay percentage as "a" and the difference between the percentages of sand and clay as "Δ," for type 1 soils, we have: $10\% \leq a < 15\%$ or $a \geq 15\%$ with $\Delta \geq 50$. The analysis showed a sand content of 81.25%, silt 7.50%, and clay of only 11.25%.

The results for type 1 soil indicated the need for organic matter insertion, a minimum condition necessary for the action of microorganisms that, in partnership with moisture and other factors, can provide many benefits through enzymes, bioactive substances, amino acids, nucleic acids, etc., produced by various species, positively influencing, directly or indirectly, plant growth and soil quality. According to previous studies, some bacteria have been identified as growth promoters, potentially increasing plant productivity by making nutrients such as nitrogen (N), phosphorus (P), potassium (K), and zinc (Zn) available to plants (ASHRAF; RASOOL; MIRZA, 2011; DE SANTI FERRARA et al., 2012; GHEVARIYA; DESAI, 2014). It is estimated that in Brazil, approximately 70% of the nitrogen required for certain sugarcane varieties comes from biological fixation (CHAUHAN; BAGYARAJ; SHARMA, 2013). Figure 1 shows the soil collected for analysis.

Fig. 1: Sample of soil from the entire property, which has 10.4 hectares of land.

Source: Viviane Mallmann.

"Based on the results, actions were taken to address issues in the soil, like acidity. Many effective methods have been studied in Brazil, and tests have shown which approaches are effective. Recognizing that significant changes were necessary, conventional methods were not feasible. With low clay content, the use of lime and industrial fertilizers would lead to quick leaching and unsustainable replacements. Thus, the goal was to restore soil microbiota diversity, increase humidity to support life, and cover the soil with organic matter to sustain nutrient cycles naturally, eventually achieving a self-sustaining system. This agroecological approach demonstrates sustainable production in agro-ecosystems by fostering balance among plants, soils, and organisms (Altieri, 1989). The plan leveraged natural resources on the property and introduced new ones.

Syntropy: In agroecology, syntropy is a concept developed by Ernst Götsch. It involves moving from simple to complex systems, fostering interdependence and organization, much like a natural forest ecosystem that sustains itself while producing food."

5.2 - "Introduction of the method"

5.2.1.- Effective Microorganisms (EM)

The rural property was entirely covered with Brachiaria grass (Brachiaria sp.). The first step

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involved mowing the grass and leaving it on the soil as a vegetative cover. The aim was to gradually replace this pasture with other desirable agricultural crops. By leaving the cut grass on the ground, sunlight was blocked, which led to the natural die-off of some of the pasture plants due to smothering. A large tarp (9m x 90m) was then placed over the area, moving it every ten days to completely eliminate the grass without using pesticides, as seen in Figure 2."

Fig. 2: Initial process of soil occupation and transformation."

Source: Viviane Mallmann.

Obs.: "Mowing the pasture. The tarp is fixed for ten days to halt the growth of some pasture plants that survived. The result achieved is soil cover with the organic matter available in the area."

With the soil covered in organic matter, moisture was maintained beneath the cut grass, creating ideal conditions for the next step: introducing effective microorganisms (EMs). These microorganisms, essential due to their complex activity, made industrial nutrients unnecessary. The EMs were captured using an organic farming technique, placing cooked rice in a wooden trough, covered and left in a preserved forest area to attract local soil microorganisms. After one week, the microorganism-infused rice was ground with water and sugar, fermented for ten days, and then sprayed over the prepared area.

5.2.2. - Homeopathy, Green Manure, and Composting

The next agroecological step involved introducing homeopathy, carefully chosen per Vithoulkas (1980) and Casali et al. (2006) to harmonize living systems within agroecology. Once the soil was covered with decomposing organic matter, essential for effective homeopathy, two custom-made solutions (CH6 potency) using dolomitic lime and diverse soil samples were applied to detoxify the soil from prior pesticide use. Further treatments included Alumina CH6 and Calcarea carbonica CH6, visibly reducing toxic aluminum levels. Green manure with jack bean and Crotalaria was added, improving nitrogen fixation. Later, various crops generated substantial income, showing improved nutritional quality.

Fig. 3: Process of capturing microorganisms in the forest.

Source: Viviane Mallmann.

Fig. 4: Food production in the mandala system.

Source: Viviane Mallmann.

Fig. 5: Implementation of agroecological cassava planting.

Source: Viviane Mallmann.

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Fig. 6: From planting to harvest: Cucurbitaceae.

Source: Viviane Mallmann.

Fig. 7: Harvesting rice.

Source: Viviane Mallmann.

Fig. 8: Grape vine.

Source: Viviane Mallmann.

This effort was a family endeavor, emphasizing the importance of family in establishing this work and living system. Upcoming phases include implementing more complex components, such as planting fruit and exotic seedlings and native trees in an agroforestry system, expected to yield financial returns within three years. Currently, the family sustains themselves through annual cycle plants, with fruit seedlings to be introduced in August 2017 after acclimatization. Beekeeping will also be integrated after the fruit seedlings are planted.

6. Conclusion

This work presents significant data and results for agriculture, highlighting the viability of a complex system that, when understood and implemented in stages, can transform food production. It emphasizes the importance of community collaboration and the role of each organism in the ecosystem, promoting life and balance. Sustainability emerges as a central goal, allowing families to remain on the land and contribute to a model that not only meets the needs of many but also fosters collective happiness and well-being.

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