

Production of Fertilizer from Solid Organic Waste at the Francisco de Paula Santander School¹

Producción de Abono a través de los Residuos Sólidos Orgánicos de la Escuela Francisco de Paula Santander

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Abstract-- Solid wastes are wastes from human activities that are considered useless, undesirable or disposable by those who generate them, but which may be useful to other people. This article focuses on the production of fertilizer through waste management at the Francisco de Paula Santander School. The study is based on assumptions drawn from the community. Focus groups and interviews were conducted with the school's teachers, parents and students. The end product is a set of strategies designed to use, minimize and adequately transform the Organic Solid Wastes produced at the Francisco de Paula Santander School for production of organic fertilizer through composting, and the educational community will promote an environmental culture through the use of solid wastes.

Keywords-- Solid waste, fertilizer, strategy, production, composting

Resumen-- Los residuos sólidos son los restos de actividades humanas, considerados por sus generadores como inútiles, indeseables o desechables, pero que pueden tener utilidad para otras personas. El presente artículo se enfoca en el diseño de abono a través del manejo de residuos en la Escuela Francisco de Paula Santander dentro de la investigación se encuentran supuestos extraídos desde la comunidad. Se realizaron grupos focales y también se aplicó una entrevista a docentes, padres de familia y estudiantes de la IED. Como conclusión se diseñaron un conjunto de estrategias que permitieron aprovechar, minimizar y transformar de forma adecuada los Residuos Sólidos Orgánicos que se producen en la Escuela Francisco de Paula Santander para la producción de abono orgánico mediante el compostaje, y es la comunidad educativa la que busca la promoción de cultura ambiental a través de la utilización de los residuos sólidos.

Palabras clave-- Residuos sólidos, abono, estrategia, producción, compostaje.

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I. INTRODUCTION

Countries are able to grow when they balance human capital, equity and production, and institutions, in various forms, have had an impact on the social and economic development of societies, but they are not the only factors or elements that contribute to development. We start out by mentioning the above because when it comes to growth, it is important to take into consideration the vantage point of the approach: social, political, religious, or environmental. The participation of individuals is necessary in order to address the issues in the context in which they arise [1].

Consequently, this study enables reflection on the fact that in Colombia there is substantial demand for the implementation of environmental education strategies, based on knowledge, attitudes, beliefs and behaviors, to achieve the transformation of current views on nature, particularly the view that no harm is done because nature has sufficient absorption capacity given the size of the world, for the satisfaction of the needs of individuals [2].

All changes in favor of the environment must start from raising awareness on the fact that the environment is a space for life that experiences positive or negative changes caused by humans. Consequently, it is through environmental education that individuals can learn about the effects on nature of the actions of each person who uses it, in addition to acknowledge that it is a resource that at some point can be exhausted [3].

The various components taken into consideration for ecological education should call upon communities not only to make adequate use of the environment, but also to learn about which actions promote its preservation and the favorable reproduction of wildlife. The educational processes that include teaching of environmental education are aimed at raising awareness [4].

Environmental education has a long way to go, but it is possible to include it in schools, not as an option for learning, but as a cross-cutting tool for everything that is taught, thereby generating sustainable options that will multiply from generation to generation [5].

When implementing teaching methods on ecology, the main focus should be on values, because responsibility, commitment and respect for the environment should predominate in shaping attitudes, skills and abilities, promoting the socially responsible participation of all those involved [5].

A. ENVIRONMENTAL EDUCATION

Some aspects that were developed during the project were the promotion of an environmentalist culture, or environmental awareness, which according to (Simmons, 2000) the North American Association for Environmental Education, "must be fair and accurate in the description of the various environmental issues, situations and conflicts; must provide a balanced pre-

sentation of the different points of view and theories about them, and about the areas of consensus, including organizations and associations, as well as official policies."

Environmental education should promote reflection and awareness of individual behaviors towards the green spaces that we come into contact with daily. These are the contexts that play a key role in the development of attitudes and behaviors based on commitment and respect towards nature, promoting the reassessment of collective lifestyles. [6].

Environmental education should also be carried out with an effective teaching process in which the teacher's method is consistent with the interests and motivations of students, with an open mind, with frequent references to all important aspects related to caring for the environment at the global, national, regional and especially local level.

Also, "an environmental education program should stimulate critical and creative thinking through the definition of problems, the formulation of hypotheses, data collection, organization and analysis, and conclusions that propose possible strategies for solution and that identify opportunities, develop and implement action plans and assess the results." [7]

The students must play an active and participative role, incorporating what they have collectively learned about ecology. The educational community in general should also facilitate the promotion of new alternatives to solve environmental problems, while achieving participation, promotion and coordination of human needs with the adequate use of resources [8].

After having traveled a long road on the individual's influence on the environment and the importance of environmental education, some authors point out specific cases of environmental impacts related specifically to waste management.

According to, [9] "They are waste products from human activities, considered to be useless, undesirable or disposable by those who generate them, but that may be useful to other people." As a result, solid wastes produce negative environmental impacts due to their improper disposal and because the population is constantly and quickly growing, and industrial processes and especially consumer behaviors cause negative effects to the environment, which can only be mitigated through the adequate use of organic and inorganic wastes.

The suitable use of waste therefore involves control measures covering the entire process from production to use. We do not know the exact date when agricultural organic wastes began to be used or the way they were used in the distant past. What did make a big difference was the development of urban populations with a large concentration of inhabitants, in which wastes were considered a problem that had to be eradicated, whereas in rural settings both human and animal waste products were made use of for agricultural purposes.

Conceptual definition of wastes according to Valderrama (2013).

Waste from the economic standpoint: “As a function of available resources, “wastes” are misplaced materials arising from the inefficient use of resources in the production of goods and services.”

Potential for wastes: The potential for using wastes depends on how well we know their origin, in order to know what use can be given them.

Source: Authors.

Classification of wastes	Types of waste
Inorganic wastes: “they include all wastes of a mineral origin and substances or compounds synthesized by man.”[12]	Metals Plastics Cans Scrap metal Glass
Organic wastes: [11]. “They refer to all wastes that originate in living beings, animals or plants.” Without much effort, these can be easily recovered to be reused, given the wide variety of wastes that are generated, “naturally over their “life cycle”, as a result of the physiological maintenance functions and perpetuation, or resulting from the use by mankind of biotic resources.”[10]	Food wastes Animal manure Gardening wastes, among others.

Source: Authors.

Handling of solid wastes is a matter of interest for entities that seek to protect the environment and to promote in individuals an environmental culture in their actions. Consequently, it is important to know the conceptual definitions of this topic.

[11]. Municipal solid wastes are “all solid and semi-solid materials produced by human societies that are disposed of as useless or undesirable because withholding them is considered of no value.”

[12] says “they are by-products from the activities carried out in homes, offices, trade and industry (also known as trash or garbage). Such wastes can be sub-divided into organic, such as waste from food, leaves and gardening wastes, paper, cardboard, wood and in bio-degradable materials in general; and inorganic, such as glass, plastic, metal, rubber products and other inert materials”.

B. AGRICULTURAL ACTIVITIES AS A SOURCE OF ORGANIC WASTES

Agricultural activities produce a variety of wastes of both plant and animal origin. “Plant wastes include wastes from harvests and crops (stems, fiber, husks, bagasse, stubble, wastes from pruning, fruits and others) derived from the various crops.”[10] The water content of these wastes varies depending on several factors; for example, wastes from harvesting can be up to 90%, specifically in mud, wastewater and other liquid wastes.

The particularities of water content can have substantial influence on the treatment of organic wastes. In the case of animal wastes, for example, these include solid and semi-solid excrements and slurries, waste from chores, carcasses, waste from serum and milk, among others. “Manure is gener-

ally described as any mixture of excrements, urine and wastes such as vegetation materials such as hay, straw or animal bedding materials.”[10]

Organic wastes such as manure have specific compositions depending on the agricultural practices. Due to its characteristics, this waste is rich in nitrogen, phosphor and potassium, and varies depending on the type of cattle, their diets and production conditions. In the specific case of slurries, they are high in water content and are handled as liquids. As mentioned earlier, these wastes have a substantial impact on the environment [10].

C. ALTERNATIVES FOR TREATMENT OF ORGANIC WASTES

The government has made joint efforts to recover and reuse wastes to turn them into highly useful inputs, especially in the case or organic wastes that require biological transformation. “When in a system the thermodynamic variables are changed: pressure, temperature, volume, etc., it is known as a thermodynamic process.” [13] Biological processes are those that enable the production of biogas and composting [14]. Some products from the reuse of organic wastes include animal feed, sources of energy, and raw material for production of organic fertilizer [10].

D. ORGANIC WASTES AS RAW MATERIAL FOR THE PRODUCTION OF ORGANIC FERTILIZER

[14] “Organic fertilizer makes reference to any organic material used to improve soil structures and to fertilize crops.” “Organic fertilizer is considered any material of animal or plant origin that is used primarily to improve soil characteristics, as a source

for life and nutrients for the soil.” Organic fertilizers may be either solid or liquid.

In Colombia, resolution No. 0074 of April 4, 2002 was issued aimed at promoting interest and consumption of ecological products. Article 5 of Chapter III of this resolution indicates that a variety of production systems can increase the biological work of the soil to balance biological and natural factors [14].

Throughout history, manure and slurries have been used as organic fertilizers, including manure from cattle, composting of materials from rural and urban areas, wastes from other types of animals, and wastes from farm work.

“A technique that enables this controlled biodegradation of organic matter before incorporating it into the soil is composting, the end product of which is known as Compost.” There are different alternatives and methods to make use of agricultural solid wastes, including the production of fertilizers of the Bocashi, Trophobiotic Culture and Compost types [14].

E. COMPOSTING

According to [10], composting “Is the collection of organic wastes produced during agricultural production processes to convert them into inputs that can be returned to the soil, contributing beneficial nutrients and microorganisms to improve water retention and cation exchange capacity and to improve production yields.” It is considered a stable product with a pleasant smell and a wide variety of beneficial properties for the soil, plants and even animals and they generate oxygen for natural plantations.

F. RAW MATERIALS FOR THE COMPOSING PROCESS

Organic materials are ordinarily suitable for composting, including “waste products from plants and harvests (broken branches, trimmings, fallen leaves, dry fruit peels, hay and grass); porcine, bovine, caprine and ovine manure and their corral beds; kitchen organic wastes in general (fruits and vegetables, spoiled foods, egg shells, dry fruit husks, orange, citric and pineapple peels); edible oils and fats (spread out and in small quantities); sawdust and shaves (in thin layers); and napkins, tissues, paper and cardboard (not printed or colored).”[11] Some items not suitable for composting are remains from unhealthy plants, rotten meat, excessively fatty products, necrotic materials, etc.

An important element when using organic wastes is separation, particularly for composting. It should be taken into account that the effectiveness of the process depends on the presence of nitrogen, and excess nitrogen can generate ammonia, which may produce unpleasant smells [15].

[15]. “The organic wastes that are suitable for composting are: household wastes, wastes from

trimming and cleaning parks and gardens, horticultural and fruit wastes, food industry by-products and waste from greenhouse harvests or orchard plantations.”

VII. METHODOLOGY

This study is qualitative in nature, based on a socio-critical paradigm, [16] given that research of this type enables interpreting and understanding the reality of the phenomena under study. Participative action enables access and insertion in order to describe the particularities of those being observed. For data collection purposes, initially semi-structured interviews were made with participants, combined with observation, as recorded in field journals [17].

The study participants were the educational community of Francisco de Paula Santander, with a total of (30) persons, with the following breakdown: (10) students, (10) parents and (10) students. The following procedure was used for this study:

Stage (1): Initially a diagnosis was made based on interviews with the participating community, consisting of 5 questions aimed at gathering key and relevant information on organic solid waste management.

Stage (2): Based on the diagnosis, a meeting was held with parents to publicize the project and gain their support in reinforcing the activities to be carried out at the school.

Stage (3): A location was selected for performing composting, to which end an event was organized and held with students, teachers and some parents.

Stage (4): Preparation and separation of the materials to be implemented. The vegetation material for the organic fertilizer was distributed and the solid materials were organized, teaching the children the importance of separating their waste depending on their type.

Stage (5): Once the materials had been collected, preparation of the organic fertilizer began, which is to be used as fertilizer for the plants in the garden, orchard and other plants. First the materials were mixed by turning and mixing the various wastes, and water was added to obtain the appropriate consistency. The prepared organic material was put into sacks and placed at the selected location. This was carried out with materials from the environment and no water content measurements were taken because no suitable instruments were available to measure such quantities.

Stage (6): Post-activity interviews were made in order to understand and interpret significant views of the population regarding solid waste management and use.

Stage (7): The project results were prepared and all significant contributions were recorded in a field journal, aimed at comparing them to the diagnosis and the research objectives.

VIII. RESULTS

The following are the results derived from the instruments used, according to the categories of the study.

IX. CONCLUSIONS

Lastly, we can say that our final goal was accomplished, which was to evaluate the effect on the environment of the production of organic fertilizer. The high level of motivation and willingness of the participants to perform the activities is worth highlighting.

It should be noted that the initial activities required time and dedication; at first some of the material was wasted, but this should improve once the fertilizer is produced on a recurrent basis.

The production of fertilizer from organic wastes did have a favorable effect on environmental pollution, because the school community was used to throwing their waste anywhere, failing to know the good they could do by recycling these wastes. Currently wastes are being managed responsibly, and people are able to separate and correctly classify the wastes that can be used.

Exactly when people began to use organic wastes is unknown, but the scale of the problem is very different with the development of highly concentrated urban populations, where wastes are considered a problem that must be eradicated, whereas in rural areas they were able to use both human and animal wastes for agricultural uses [18].

The educational community in general is committed to continuing to work on the use of the solid wastes, because they recognize that caring for the environment should become a public policy that promotes the citizenship culture of individuals in a society.

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Diagnosis	Assumptions	Purposes	Verification
Inadequate management of the solid wastes produced by the school cafeteria at the Francisco de Paula Santander School, as a result of a low level of environmental culture and lack of knowledge on how to handle wastes, which produces pollution at the school, its surrounding areas and the community in general.	If the organic wastes are used to make fertilizer, we will pollute less and help build an environmental culture.	Learn how the educational community at the Francisco de Paula Santander School was handling organic solid wastes.	The educational community at the Francisco de Paula Santander School actively participated in the interviews, which contributed to starting the process of preparing organic fertilizer to reduce pollution and generate an environmental culture.
		Produce fertilizer from organic wastes	Performance of the various strategies with the students, parents and teachers led to performing the solid waste composting process. It was found that the distribution of the organic material and processing of the mix accelerated the breakdown of the materials, thereby producing organic fertilizer, which was beneficial for the school gardens, orchards and fruit trees.
		Verify whether production of organic fertilizer reduced pollution and generated an environmental culture.	The amount of garbage in the surrounding area of the School and the community is lower. The participants engage in daily activities related to organic wastes, and the environment also looks cleaner. The adults have continued to put into practice and to teach children how to treat wastes, thereby creating favorable habits for the environment.

Source: Authors.

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