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PROJECT SIBOL: Utilization of Waste Vegetables from Barangay Baligatan, City of Ilagan Public Market as Organic Fertilizer

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ABSTRACT: The study *"Project SIBOL: Transforming Waste Vegetables from Barangay Baligatan Public Market into Organic Fertilizer"* explores the conversion of biodegradable market waste into eco-friendly organic fertilizer. Conducted in Ilagan City, Isabela, the research promotes sustainability, waste reduction, and agricultural productivity through the innovative recycling of discarded vegetables. The fertilizer was developed using a mixture of waste vegetables, water, and brown sugar, producing two by-products: foliar (liquid) and granular (powder) forms. Sensory evaluation among fifteen (15) farmers aged 40–75 assessed the fertilizers' appearance, texture, aroma, color, effectivity, and marketability using a 5-point Likert scale. Statistical analysis revealed both products as acceptable, with the granular fertilizer receiving the highest level of preference. No significant difference was found among age groups, indicating broad acceptance across farmer demographics. Findings highlight waste vegetable fertilizer as a sustainable, cost-efficient, and environmentally friendly alternative to chemical fertilizers. The project underscores the potential of waste-to-fertilizer innovation to enhance soil fertility, reduce pollution, and foster community-based green entrepreneurship.

KEYWORDS: Waste management, organic fertilizer, Project SIBOL, sustainability, circular economy, Ilagan City, Isabela

I. INTRODUCTION

In recent years, the sustainable management of agricultural and market waste has become a crucial aspect of environmental stewardship and resource efficiency. Project SIBOL aimed to address this challenge by transforming waste vegetables from Barangay Baligatan Public Market in the City of Ilagan into valuable organic fertilizer.

Barangay Baligatan Public Market, a vibrant public market in the City of Ilagan, generated significant quantities of waste vegetables daily. Traditionally, this organic waste was discarded or inadequately managed, leading to environmental issues such as landfill overflows and greenhouse gas emissions. However, we can repurpose this waste as a potential resource to boost agricultural productivity and encourage sustainable farming practices.

Project SIBOL harnessed this underutilized resource through an innovative recycling approach. By converting waste vegetables into organic fertilizer, the project converted waste vegetables into organic fertilizer, reducing environmental pollution but also providing local farmers with a cost-effective and eco-friendly alternative to chemical fertilizers. Organic fertilizers improved soil health, increased crop yields, and contributed to sustainable agricultural practices.

This research explores the methodologies for processing waste vegetables into high- quality organic fertilizer, evaluates the effectiveness of the fertilizer on local soil and crops, and assesses the environmental and economic benefits of the project. By integrating waste management with agricultural productivity, Project SIBOL exemplifies a holistic approach to sustainable development, aligning with broader goals of waste reduction, resource efficiency, and environmental conservation.

Through this initiative, Project SIBOL aimed to set a precedent for similar efforts in other regions, fostering a culture of sustainability and resilience in agricultural communities.

Waste Vegetables

According to the DOST-FNRI (2020), household plate waste in the Philippines consisted of 57 g (73.8%) of cereals and cereal products, with vegetables coming in at 8 g (10.8%) and fish, meat, and poultry at 9 g (11.1%). This led to rotting and imperfect material that was missed in the field. Dealing with disposed products correctly safeguards the person responsible for the materials and lessens the chance of environmental harm. In their research, Ahmed et al. (2022) claimed that garbage disposed of in landfills decomposed and released greenhouse gases, along with odors, diseases, and epidemics, due to the disintegration process. The goal of the research was to recycle household waste to create organic fertilizer. Through this research, it was possible to gather household waste food, which served as a source of nitrogen, as well as the leftovers from cleaning and pruning different trees, lawnmowers, and the use of sawdust white wood, which served as a source of carbon.

Without a doubt, composting was a crucial and essential waste management technique. Composting was one more environmentally acceptable method of handling organic waste. Furthermore, composting enhanced soil fertility and structure (Bratovcic et al., 2018).

Organic Fertilizer

Organic fertilizers were readily available mineral sources that had a modest concentration of vital minerals for plants. Organic fertilizers come in two varieties: unprocessed (manure and slurry) and processed (compost, blood meal and humic acid, fish meal, feather meal, and naturally digested proteins). In the past, organic fertilizers acted as slow-release fertilizers since they released nutrients gradually over a longer period of time. These three macronutrients—nitrogen (N), phosphorus (P), and potassium (K)—were crucial for plant growth. The soluble nitrogen included in synthetic or quick-release fertilizers is highly soluble in water. In contrast, most organic fertilizers functioned as slow- release fertilizers because they contained a balanced amount of raw nitrogen. Organic fertilizers reduced the likelihood of eutrophication, contaminated groundwater, and overfertilization.

The ideas of Panuccio et al. (2022) and Ahmed and Abdulla (2018) were similar in suggesting that an efficient way to produce organic fertilizer was by recycling household waste food, which served as a source of nitrogen, and using sawdust white wood, which served as a source of carbon, and the leftovers from cleaning and pruning different trees.

Benefits of Organic Fertilizer

In contrast to chemical fertilizers, organic fertilizers contained components that were leftovers from plants, animals, or minerals. These sources of decomposing materials break down organically and replenish the soil with nutrients and minerals. To maintain a healthy lawn, it was important to ensure that the garden lawn received all the nutrients required for growth. Even if typical soil contains nutrients, fertilizers supplied and guaranteed that the plant had an adequate and balanced supply of nutrients. Proper lawn care also took into account the lawn and garden's overall health. Starting a compost pile was an excellent approach to getting rid of food waste and yet helping the environment and grass. It was a crucial and worthwhile choice that supported healthy soil and environmental conditions while generating the greatest plant life.

The majority of chemicals found in synthetic fertilizers were not readily biodegradable. These substances seeped into the ground and eventually ended up in the water system, where they were eaten by wildlife and birds. On the other hand, even with increased use, organic fertilizer did not pose this risk because it contained no such dangerous substances. Furthermore, children and cats that played in the garden or on the grass were immediately put in danger when synthetic fertilizers were sprayed on plants and lawns. When employing these toxins, care had to be taken and exposure had to be restricted. Organic fertilizers did not induce leaching and lower soil acidity compared to chemical fertilizers. They didn’t eliminate the soil's helpful microbes.

Additionally, organic fertilizers aided in enhancing the soil's structure by promoting air circulation, which supported healthy microbes that aided in the release of nutrients into the soil. Groundwater contamination in many agricultural areas results from synthetic pesticides and fertilizers. By using more biodiversity, organic fertilizers improved soil structure and water infiltration. Increased nutrient retention in well-managed organic systems significantly lowered the danger of groundwater contamination. Because organic farming may trap carbon in the soil, it helped mitigate the greenhouse effect and global warming.

The study was a thorough investigation into waste vegetables as the main element in producing a by-product organic fertilizer prior to its ability to produce beneficial features.

Specifically, the study sought to answer the following questions:

1.What was the procedure involved in developing Waste Vegetable Fertilizer?

2.What was the level of acceptability of Waste Vegetable Fertilizer in terms of:

a. appearance;

b. texture;

c. aroma;

d. color?

3.What was the level of effectivity and marketability of the waste vegetable after farmers tested it for two (2) weeks?

4.Was there a significant difference in the level of acceptability of each product of fertilizer developed from Waste Vegetables among three-aged group?

a.40-51

b.52-61

c.62-75?

This study was governed by the null hypothesis, which stated: “There was no significant difference in the level of acceptability of the waste vegetable fertilizer among the three-aged group.”

This study was conducted through a limited sampling of respondents, which will include fifteen (15) individuals who were five (5) Corn farmers, five (5) Vegetable planters, and five (5) Rice planters within the vicinity of Barangay Naguillian Sur, Ilagan City, Isabela, ages 40-75.

The result of this study was significant because of the benefits it could offer to various stakeholders, including:

The Farmers. The study supported them in boosting agricultural biodiversity and soil fertility. Since the ingredients used in making organic fertilizers were biodegradable materials found nearby, the knowledge and best practices acquired from this research will enable them to reduce agricultural input expenses.

The Community. The study enhanced the physical, chemical, and biological properties of the soil, regenerating soil fertility and improving crop quality through backyard gardening using organic methods.

The Environment. The use of organic fertilizers offered advantages, including affordability, enhancing soil texture, aeration, structure, and water retention, promoting healthy root growth. This study prevented waste spreading and advocated proper waste use. It will also help the environment to breathe properly by avoiding chemicals.

The Consumer. The study helped consumers save money by reducing expenses on chemical fertilizers.

The Vegetable Business Owner. The study facilitated waste recycling from vegetable goods and reduced marked clutter, benefiting vegetable business owners.

The Future Researchers/Students. The result of this study provides them a basis for an intensive investigation on the acceptability and development of waste vegetables as fertilizer.

II. METHODOLOGY

Research Design

In this study, the researchers used the experimental survey method. The facts gathered are the information regarding the preparation of waste vegetable fertilizer. The research was completed by the use of assessment instruments like questionnaires and checklists. The respondents' ratings are recorded, tallied, collated, analyzed, and interpreted.

Materials and Methods

A. Materials

1.Ingredients

Table 1 shows the ingredients and their proportion in the preparation of Acceptability and Effectiveness of Waste Vegetable Fertilizer that was used in the study. 1 kilogram of waste vegetables, 3 Liters of water, and ½ kilogram of brown sugar.

Table 1. Proportion and unit of measurements of ingredients that were used in Waste Vegetable Fertilizer.

Ingredients	Quantity	Unit Of Measurement
Waste Vegetables	1	Kilogram
Water	3	Liters
Brown Sugar	1/2	Kilogram

2. Equipment, Tools and Utensils

In preparing the Waste Vegetable Fertilizer, the following equipment, tools, and utensils are utilized: Liquid Measuring Cup, Weighing Scale, 1 Large Jar (for soaking), Metal Strainer, Oven, and Blender.

B. Treatment of the Study

There is one treatment that is utilized in this study and two by- products, which are foliar (liquid form) and granular (powder form). The treatment comprises 1 (one) kilogram of the Waste Vegetable, 3 (three) liters of water, and ½ (one-half) kilogram of sugar. The treated waste vegetable is drained, and the liquid serves as product number one, which is the foliar, and the waste vegetable is sun-dried, oven-heated, and crushed using a blender and serves as the second product, which is the powder or granular fertilizer; hence, we look forward to which is well and effective in the two (2) by- products developed.

C. Processes will be Applied in Making Waste Vegetable Fertilizer

The following present the processes and procedures for making the Waste Vegetable Fertilizer.

1.Collection and Preparation of the Material

The waste vegetables are collected from the Barangay Baligatan, City of Ilagan Public Market. The waste vegetables that we collect have been washed immediately before making or doing the proportion for the treatment.

1.1 Collecting of Waste Vegetable

1.2. Prepare and measure the ingredients.

2. Mixing and developing the Material.

The process of developing the waste vegetable fertilizer deals with a scientific formulation regarding the activation of the brown sugar use. This process provides careful procedure to meet exact formulation prior to the next process of the development, which is the soaking.

2.1 Dissolve brown sugar in 1 liter of lukewarm water. Add ½ kilogram of brown sugar and 1 liter of lukewarm water to dissolve.

2.2 Mix all the ingredients in one large jar with additional 2 liters of water.

3. Soaking, straining, sun drying, and crushing.

This process deals with the process of filtration through the process of soaking, which is the result of the activation of organic compounds such as iron, zinc, manganese, chrome, and the like that result in providing sufficient nutrients for crops. The process for this development before going to the next process, which is the straining prior to the soaking stage.


3.1 Soaking process for four (4) days.

3.2 Straining.


3.3 Sun drying for three to four (3-4) days and put in the oven for fifteen (15) minutes at three hundred fifty degrees Fahrenheit (350◦F).

3.4 Crushing through the use of blender.

4. Bottling, packaging, evaluating, and final checking of the product.

This process is the final procedure in developing the product. Upon doing its final output, the evaluation process was eventually done by the researchers through a sampling of respondents.

4.1: Packaging and bottling of the finished product.

D. Sensory Evaluation

Sensory evaluation is conducted at Barangay Naguillian Sur, City of Ilagan, Isabela, to determine the acceptability of the waste vegetable fertilizer product in terms of appearance, aroma, texture, and color. Including the overall acceptability, effectivity, and marketability of the Waste Vegetable as Fertilizer. The instrument for data gathering is a score sheet using the 5-Point Likert Scale. The range of scale will be interpreted as follows:

Scale	Ranges of Score	Level of Acceptability
5	4.50 – 5.00	Highly Accepted (HA)
4	3.50 – 4.49	Accepted (A)
3	2.50 – 3.49	Moderately Accepted (MA)
2	1.50 – 2.49	Slightly Accepted (SA)
1	1.00 – 1.49	Not Accepted (NA)

A sensory panel of this study was composed of fifteen (15) individuals who were five (5) Corn farmers, five (5) Vegetable planters, and five (5) Rice planters. The qualification of respondents in terms of age should be 40 to 75 years old.

E. Statistical Data Analysis

The results of the sensory evaluation were statistically analysed. Meanwhile, the following statistical tools are used to completely treat the data:

1.The Five-point Likert's rating scale. This is used to determine the descriptive meaning of the indicators of the variables used.

2.Mean. This is utilized to gauge the level of acceptability, effectiveness, and marketability of the organic fertilizer.

3.Analysis of Variance (ANOVA) One-way. This is employed to determine the significant differences in the evaluations of the respondents as to the level of acceptability of the waste vegetable fertilizer across the three-aged groups along the two (2) by-products.

III. RESULTS AND DISCUSSION

This chapter presents the findings drawn from the data gathered to determine the level of acceptability, effectivity, and marketability of waste vegetable as fertilizer, along with two by-products for making the discussions, conclusions, and recommendations.

Figure 1. Sample Product developed.

A. Procedure Involved in Developing Waste Vegetable Fertilizer

The development of waste vegetable fertilizer followed a systematic procedure to ensure the proper transformation of vegetable waste into an organic fertilizer. The process involved four major stages: **collection and preparation, mixing and development, soaking and drying, and final packaging.**

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First, **waste vegetables were collected** from Barangay Baligatan Public Market in the City of Ilagan. These vegetables were **washed thoroughly** to remove dirt and impurities, then **measured and prepared** for treatment.

Next, in the **mixing and developing stage**, **½ kilogram of brown sugar** was **dissolved in 1 liter of lukewarm water** to activate fermentation. The dissolved mixture was then **combined with the prepared vegetable waste** and **2 additional liters of water** in a large container to initiate the breakdown of organic matter.

The third stage involved **soaking, straining, sun drying, and crushing**. The mixture was **soaked for four days** to allow nutrient activation, followed by **straining** to remove excess liquid. The remaining solid materials were **sun-dried for three to four days** and then **oven-dried for 15 minutes at 350°F** to remove moisture. After drying, the material was **crushed using a blender** to produce fine particles suitable for fertilizer use.

Finally, in the **bottling and packaging stage**, the finished fertilizer was **packed and sealed** in clean containers. The researchers then **conducted an evaluation** to ensure that the final product met the desired quality and effectiveness standards.

B. Level of Acceptability of Waste Vegetable Fertilizer along the Two By-Products.

The following tables present the level of acceptability, general acceptability, and significant difference in the evaluations of the respondents across their age groups applying the different treatments and proportions.

Table 2. Level of Acceptability of Waste Vegetable Fertilizer along Product 1

Product 1	Sensorial Criteria	Mean	Qualitative Description
	Appearance	3.80	Accepted
Foliar	Aroma	3.20	Moderately Accepted
	Texture	3.80	Accepted
	Color	3.93	Accepted
	Overall Weighted Mean	**3.68**	**Accepted**

Table 2 presents the evaluation of the respondents in the level of acceptability of Waste Vegetable Fertilizer along two by-products, which are foliar (liquid form) and granular (powder form). The treatment comprises 1 (one) kilogram of the waste vegetable, 3 (three) liters of water, and ½ (one-half) kilogram of sugar.

As seen in the table, the appearance (3.80), texture (3.80), and color (3.93) were rated "*Accepted,*" while the aroma (3.20) was rated "*Moderately Accepted*". Meanwhile, the computed overall weighted mean is 3.68, which is interpreted as "*Accepted*". This shows that Product 1 has a strong liking for the evaluators.

Table 3. Level of Acceptability of Waste Vegetable Fertilizer along Product 2

Product 2	Sensorial Criteria	Mean	Qualitative Description
	Appearance	4.50	Highly Accepted
Granular	Aroma	4.40	Accepted
	Texture	4.40	Accepted
	Color	4.40	Accepted
	Overall Weighted Mean	**4.43**	**Accepted**

Along product 2 (two), which is granular, the aroma (4.40), texture (4.40), and color (4.40) of the waste vegetable fertilizer were rated "*Accepted,*" while the appearance (4.50) was rated "*Highly Accepted*". The overall weighted mean of 4.43 was described as "*Accepted*". This goes to show that the waste vegetable fertilizer using product 2 (two) was very tremendously preferred by the evaluators.

C. Level of Marketability and Effectivity of the Waste Vegetable Fertilizer along the Two By-Products.

The following tables present the level of marketability, effectivity, and significant difference in the evaluations of the respondents across the three-aged groups along the two by-products.

Table 4. Level of Marketability of the Waste Vegetable Fertilizer from the Two By- Products.

Products	Mean	Qualitative Description
Product 1 (Foliar)	3.26	Moderately Marketable
Product 2 (Granular)	4.20	Marketable
Overall Weighted Mean	**3.73**	**Marketable**

As to the level of marketability of waste vegetable fertilizer using the 2 (two) by- products, it has been found out that the waste vegetable fertilizer from product 1 (one) is "*Moderately Marketable*" (3.26), while product 2 (two) is "*Marketable*" (4.20) due to its fertilizer value, which is most preferred by the evaluators.

As a whole, the computed overall mean of 3.73 falls under the qualitative description of "*Marketable*". This shows that the waste vegetable fertilizer is saleable. One important component of an organic farm is the use of organic fertilizers and pesticides. The availability of these components supports the steady growth and development of our crops and even our live stocks. These could be achieved by preparing or producing the different organic concoctions and extracts.
https://car.tesda.gov.ph/tesdacar/importance-of-organic-fertilizers-and-pesticides-in-organic-farming/

Table 5. Level of Effectivity of the Waste Vegetable Fertilizer from the Two By- Products after 2 weeks of trying the fertilizers.

Products	Mean	Qualitative Description
Product 1 (Foliar)	4.10	Effective
Product 2 (Granular)	4.46	Effective
Overall Weighted Mean	**4.28**	**Effective**

As to the level of effectivity of waste vegetable fertilizer using the 2 (two) products, Table 6 presents the data of interest. Product 1 (one) is "*Effective*" (4.10), while product 2 (two) is "*Effective*" (4.46).

The computed overall weighted mean of 4.28 falls under the qualitative rating of "*Effective*." This shows that waste vegetable fertilizer along the 2 (two) by-products is effective, but product 2 (two) is most likely preferred by the evaluators.

The organic fertilizer market is expected to experience significant growth over the forecast period due to factors including the growing need to boost agricultural production and increased awareness of the detrimental effects of chemical inputs and the positive effects of organic fertilizers. https://www.futuremarketinsights.com/reports/organic-fertilizer-market

D. Test of Difference in the Level of Acceptability of the Waste Vegetable Fertilizer as Evaluated by the Three-aged Groups of Farmers.

The following tables show the test of the difference in the level of acceptability of the waste vegetable fertilizer along the two (2) by-products. The products were evaluated by the three-age group.

Table 6. Significant Difference in the Level of Acceptability of the Waste Vegetable Fertilizer as Evaluated by the Farmers in Three-Age Group.

Age Group	**40 years old – 51 years old**					
Source of Variation	**Sum of Squares (SS)**	**Degree of Freedom (DF)**	**Mean Square (MS)**	**F-value**	**Table Value**	**Remarks**
Between Groups	.260	2	.130	1.210	9.55	Insignificant
Within Groups	.323	3	.108			
Total	**.583**	**5**				

As reflected in Table 6, the computed F-value is 1.210, while the Critical Value is 9.55 higher than the F-value computed. At 5 degrees of freedom, the F-test exhibited an "*Insignificant*" result. This goes to show that there is no significant difference in the evaluation of the respondents under ages 40-51 as to the level of acceptability of the waste vegetable fertilizer along the two (2) by-products. Meaning, they have the same perceptions as to the appearance, aroma, texture, and color of the waste vegetable fertilizer out of 2 (two) by-products. Hence, "*Accept*" the null hypothesis.

Table 7. Significant Difference in the Level of Acceptability of the Waste Vegetable Fertilizer as Evaluated by the Farmers in Three-Age Group.

Age Group	**52 years old – 61 years old**					
Source of Variation	**Sum of Squares (SS)**	**Degree of Freedom (DF)**	**Mean Square (MS)**	**F-value**	**Table Value**	**Remarks**
Between Groups	.281	2	.141	4.500	199.50	Insignificant
Within Groups	.031	1	.031			
Total	**.313**	**3**				

As reflected in Table 7, the computed F-value is 4.500, while the Critical Value is 199.50 higher than the F-value computed. At 3 degrees of freedom, the F-test exhibited an "*Insignificant*" result. This goes to show that there is no significant difference in the evaluation of the respondents under ages 52-61 as to the level of acceptability of the waste vegetable fertilizer along the two (2) by-products. Meaning, they have the same perceptions as to the appearance, aroma, texture, and color of the waste vegetable fertilizer out of 2 (two) by-products. In this case, "*Accept*" the null hypothesis of the study.

Table 8. Significant Difference in the Level of Acceptability of the Waste Vegetable Fertilizer as Evaluated by the Farmers in Three-Age Group.

Age Group	**62 years old – 75 years old**					
Source of Variation	**Sum of Squares (SS)**	**Degree of Freedom (DF)**	**Mean Square (MS)**	**F-value**	**Table Value**	**Remarks**
Between Groups	.008	1	.008	.086	10.13	Insignificant
Within Groups	.292	3	.097			
Total	**.300**	**4**				

As to ages 62-75, the computed F-value is .086 and the Critical value is 10.13. At 4 degrees of freedom, the F-test exhibited an "*Insignificant*" result. This goes to show the responses of the respondents as to the appearance, aroma, color, and texture of the product are the same. Hence, there is no significant difference in the evaluation of the respondents under the. So, the null hypothesis of the study is "*Accepted*".

IV. CONCLUSION

Based on the findings of this study, the study concludes that waste vegetable materials collected from the Barangay Baligatan, City of Ilagan Public Market, can be effectively utilized to create an organic fertilizer that is fairly feasible and helpful for local farming. In this case study, two forms of waste vegetable fertilizers were foliar fertilizer, which was in liquid form, and granular fertilizer, which was in a powdery form. Attributes such as appearance, texture, aroma, and color both showed desirable results, though the granular fertilizer was most preferred by the evaluators.

The results of the marketability and effectivity tests indicate that both types have value, but granular fertilizer was perceived to be more marketable and effective due to its solid powder form and efficiency after being used by the farmers for two weeks. This evidence supports other studies that have noted the role of organic fertilizers in supplying important nutrients like nitrogen, potassium, and phosphorus to improve soil fertility and boost crop productivity. This organic fertilizer also serves as an eco-friendly substitute to chemical fertilizers, enhancing the features of the soil, such as soil texture and water- holding capabilities, without exposing the soil to the dangers that come with chemical fertilizers.

In terms of acceptability, there was no significant difference across three -aged groups, with all the people ages viewing the fertilizers as acceptable. This study also indicates the advantages of using waste vegetable material, as it cuts landfill waste and emissions of greenhouse gases but at the same time offers a local, organic source of farming. This study will go along the way in enhancing proper waste disposal and management, foster more efficient use of available resources, and inspire research in the future to find ways to transform waste into valuable products for agricultural use.

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