American Journal of Applied Sciences and Engineering | ***ISSN 2766-7596***
Published by AIR JOURNALS | *https://airjournal.org/ajase*
12011 WestBrae Pkwy, Houston, TX 77031, United States
airjournals@gmail.com; enquiry@airjournal.org

Research Article

Strategies for Enhancing Microbial Activities to Improve Vermicomposting for Increased Soil Fertility in Enugu Agricultural Zone

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Abstract

The main purpose of this study was to determine the strategies for enhancing microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone. Three research questions in line with the purposes guided the study. Descriptive survey design was used for the study. The population for the study was 52 respondents made up of 34 male extension workers and 18 female extension workers in Enugu Agricultural Zone. There was no sampling because the population was manageable. A 36-item structured questionnaire was used for the study. The instrument was structured using a four-point rating scale for data collection and was face-validated by three experts. Two of the experts were from the Department of Technology and Vocational Education and one from the Department of Mathematics and Computer Education, all from Enugu State University of Science and Technology, Enugu. The internal consistency of the instrument was determined using Cronbach Alpha method, and a reliability coefficient of 0.73 was obtained. Mean and standard deviation were used to answer the research questions, and t-test was used to test the null hypotheses at 0.05 level of significance. The findings of the study revealed that all the items under environmental and farmers practices are the strategies for enhancing microbial activities to improve vermicomposting for increased soil fertility in Enugu agricultural zone. Also, all the items under benefits of improving microbial activities showed an overall mean score of 3.24 with a standard deviation of 0.61indicating that respondents agreed on the items. This showed that the items are benefits of improving microbial activities to enhance vermicomposting for increased soil fertility in Enugu agricultural z.one. Based on the findings, the following recommendations among others were made: farmers should make the soil environment conducive to enhance decomposition of organic matter for fast vermicomposting. Farmers should also adopt the identified practices to enhance vermicomposting.

Keywords	*Strategies for Microbial Activities; Increased Soil Fertility; Enugu Agricultural Zone*
Citation	Ugwuede, A. A. & Aneke, C. U. (2025). Strategies for Enhancing Microbial Activities to Improve Vermicomposting for Increased Soil Fertility in Enugu Agricultural Zone. *American Journal of Applied Sciences and Engineering 6(4) 12-22.* *https://doi.org/10.5281/zenodo.18334748*

Introduction

Agricultural soil refers to that soil used for growing crops, raising livestocks and other agricultural purposes. It is a vital resource that support food production, ecosystem services and human wellbeing. Iwena (2020) describe agricultural soil as that portion of land where plants are grown, animals are raised and other fibres are produced for man's use. The characteristics of agricultural soil is that the soil should be able to support plant growth, influenced by factors such as high nutrient content, a good pH value and enough organic matter (Nair 2019). The author noted that there should be good proportion of sand and clay, silt influencing soil structure positively, appropriate water holding capacity and aeration. According to Iwena (2020) for agricultural soil to produce well, there should be a balance of plant and animal residues affecting soil fertility, structure and biodiversity. It has been observed that use of chemical fertilizers and indiscriminate use of animal manure to maintain soil fertility is on a high side which Aveyard (2018) noted that it has contributed to soil pollution which has resulted to low crop yield. Prolong use of fertilizer leads to lost of soil fertility and increase soil acidity. When agricultural soil become too acidic, it results to soil degradation. According to Steven, Ugesie and Bayaerik (2018) soil degradation is decline in soil condition caused by improper use and poor management of agricultural land by farmers. The authors noted that soil erosion, deforestation, desertification, soil salinization, alkalinization and water logging are forms of soil degradation.

In Enugu State and Enugu agricultural zone in particular, soil degradation affect farmers and lead to low food production. Enugu agricultural zone naturally has verse agricultural land which is rich and is expected to be yielding enough food to sustain its population, but as a result of degradation the reverse become the case. To avert this situation, a more friendly and farming practices can be used to reverse this declining trend in global productivity and also maintain environmental protection. Among these friendly and environmental protection practices are biological and mechanical soil conservation practices such as: mulching, use of farm yard manure and vermicomposting.

Vermicomposting, also known as worm composting is a process whereby earthworms are used to break down organic waste into a nutrient –rich compost. This method utilizes specific species of earthworm, such as Eisenia Fetida (redwiggler), to consume organic matter and produce castings that are rich in nutrients and beneficial micro organism. According to Dominguez and Edwards (2015), the term vermicomposting is coined from Latin word 'Vermis' meaning the 'worms'. Vermicomposting refers to natural bioconversion of biodegradable garbage into high quality manure with the help of earthworms (Syed, Zhu, Zulfigar & Tang 2019). For effective vermicomposting, there are some activities which are necessary to be put in place. Edward (2014), outlined these activities as introduction of earthworms which will consume the organic wastes producing nutrient rich-castings, organic wastes including food scraps, vegetable peels, farm wastes and nutrient-rich compost. These nutrient rich compost are beneficial to microorganisms and humic acids making it an excellent natural fertilizer which are produced as a result of microbial activities.

Microbial activities was noted by Smith and Read (2018) as processes and functions performed by micro organisms such as bacteria, fungi, protozoa in various environment. These activities play crucial roles in decomposing organic matter, re-cycling nutrients and influencing eco-system health. Microbial activities are very useful in maintaining soil fertility, influencing nutrient availability and plant growth. According to Smith and Read (2018) Microbial activities can be enhanced through the following strategies:

i. Adding bulky agents which include incorporating materials such as straw, coconut coir, or woodchips to improve aeration and moisture retention.
ii. Mixing and turning regularly the compost pile to maintain aeration, preventing matting and promoting uniform decomposition.
iii. Monitoring and adjusting temperature, moisture and pH level and making adjustment as needed to maintain optimal condition.
iv. Introducing beneficial micro organisms or worm species to enhance decomposition and vermicomposting process.
v. Providing adequate food.
vi. Ensuring a diverse and adequate food sources for worms and micro-organisms such as fruits and vegetables scraps.

These strategies can be enhanced through maintaining effective environmental requirement of worm (vermicomposting) for increase soil fertility. These include maintaining moisture of about 60-80% humidity, ensure temperature of between 15-25^{c}c , maintain pH range of 6.5-7.5, ensure adequate aeration, maintenance of optimal carbon to nitrogen ratio of about 25:1:30:1.According to Nair (2019), strategies refers to plans or approaches designed to achieve specific goals. It can be involved in many contexts. In this context, strategies refers to identifying problem solving activities that could address ways of increasing soil fertility through vermicomposting for sustainable food production. Utilization of the above strategies can increase soil fertility.

Soil fertility according to Iwena (2020), is the ability of the soil to support plant growth and productivity. This encompasses various physical, chemical and biological properties that influences the availability of nutrient and water for plant. The biological property in this study is the use of earthworm to influence the availability of nutrients hence high soil fertility.

The key aspects of soil fertility as recorded by Iwena (2020) include nutient availability, maintaining good pH level, putting in place adequate plants and animal residues which influences soil structure, water-holding capacity, nutrient cycling and microbial activities that is present and activities of beneficial micro organisms such as bacteria, fungi, protozoa which play a crucial role in multiplication of earthworm for fast decomposition of compost materials.

Earthworm according to Ozougwu (2024) is soil inhabiting creature, tube shape, and segmented creature belonging to the phylum Annelida. They do not have any appendages or suckers but have a few hooks like chaetae for gaining hold onto the substratum. They are hermaphrodites and sexually matured worms which have a distinctive epidermal ring shaped clitellum, which has gland cells that secrete materials to form cocoon (Prakash, Jaime & Saroji, 2010). Earthworms are very relevant in increasing soil fertility as they help in:

i. the process of mineralization of organic matter hence activating vermicomposting processes.
ii. aerating the organic materials such as bulky agents, wood chips, straws among others that enhance vermicomposting process.
iii. grinding initials compost materials to produce organic matter
iv. chemical degradation for enhanced vermicomposting process.
v. biological stimulation that can enhance the process of vermicomposting.

Based on these relevance, there is need to culture earthworms in order to make the soil healthy for food production. For farmers to acquire knowledge to culture earthworm effectively, they need the services of extension workers and farmers who have been practicing vermicomposting and the use of organic matter.

Extension workers are trained personnel employed by the government with the aim of disseminating new research information on the improved techniques of farming to farmers, helping them to improve on their farming skills and general welfare, as well as the development of leadership qualities in them (Aneke 2015). In the area of the study which is Enugu Agricultural zone, these extension workers would be of great help in exposing the farmers in various ways of enhancing microbial activities to improve vermicomposting for soil fertility. These extension workers might be male or female extension workers and as a result of this they may have different views about the topic under study. For instance Owolabi, Ajayi and Akintola (2018), observed in their study carried out on utilization of organic farming techniques that male extension workers are active in reaching farmers and teaching them the various ways of engaging in organic farming than their female counterparts. Also the male extension workers are active in paying regular visits to the farmers especially those newly expose to the use of organic farming system. These discrepancies of extension workers based on their gander might be a hindrance to effective learning of farmers under the female extension staff which will lead to these farmers to continue making use of chemical fertilizer which is the gap this study want to fill.

Statement of the problem

It is worrisome that farmers make use of chemical fertilizer, pesticides, insecticides in order to enhance food production, the main problem of commercial food production is the use of chemical fertilizer which degrade the soil through soil contamination, destruction of living organisms in the soil that help to fix nitrogen and also dangerous for human to consume food produced with it. The prolong use of chemical fertilizer reduces crop yield due to

chemical accumulations in the soil and causes chemical imbalance in the soil. Adopting better strategies for enhancing microbial activities to improve vermicomposting is important because it will help to balance the chemical composition in the soil and make the soil to continue to produce high quality food that is healthy for human consumption. There is therefore need to adopt organic eco-friendly product that is easier to process and use in food production such as use of vermicomposting in Enugu Agricultural Zone.

Purpose of the Study

The main purpose of the study was to identify the strategies for enhancing microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone. Specifically, the study sought to determine the:

1. Environmental practices that could be used to enhance microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural zone
2. Farmers practices for enhancing microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural zone
3. Benefit of improving microbial activities to improved vermicomposting for increased soil fertility in Enugu Agricultural Zone.

Research Question

The following research questions guided the study.

1. What are the environmental practices that can be used to enhance microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone?
2. What are the farmer's practices that can enhance microbial activities to improve vermicomposting for increased soil fer tility in Enugu Agricultural Zone?
3. What are the benefits of improving microbial activities to enhance vermicomposting for increase soil fertility in Enugu Agricultural Zone?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance

Ho_1: There is no significance difference between the mean scores of male and female agricultural extension workers on the environmental practices for enhancing microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural zone.

Ho_2.There is no significance difference between the mean scores of male and female Agricultural extension workers on the farmer's practices for enhancing microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural zone.

Ho_3: There is no significance difference between the mean scores of male and female agricultural extension workers on the benefits of improving microbial activities to enhance vermicomposting for increased soil fertility in Enugu Agricultural Zone.

Research Method

The study adopted a descriptive survey research design. A descriptive survey research design according to Olaitan, Ali, Eyoh and Sowande (2017) is the one which specifies how data would be collected and analyzed. Uzoagulu (2013) explained descriptive survey research design as a design in which a group of people or items are studied by collecting and analyzing data from a few people or items considered to be representative of the entire group. This design was used for the study because of wide distribution of the respondents. The study was conducted in Enugu Agricultural zone. Enugu agricultural zone is one of the six agricultural zones in Enugu state. Enugu Agricultural Zone is naturally endowed with good agricultural environment favourable for crop production.

The population for the study comprised of 52 respondents made up of 34 male extension workers and 18 female extension workers in Enugu Agricultural Zone. (Source: www.ojol.info, State Agricultural Development Programe. (ESADP) (2022). The entire population was used for the study because the population size was manageable, therefore no sampling was made. A self-structured questionnaire was used as instruments for data collection. The questionnaire contains a total of 26 structured items generated from an extensive review of literature. The questionnaire was divided into three sections (A-C) in order to collect data pertinent to the research questions. Specifically Section A contained 10 items on environmental practices used to enhance microbial activities to improve vermicomposting for increased soil fertility. Section B contains 7 items on farmer's activities for enhancing microbial activities to improve vermicomposting for increased soil fertility while section C contains 9 items on benefit of improving microbial activities to improve vermicomposting for increased soil fertility. All the items are on four point rating scale with response options of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with weighting numerical values of 4, 3, 2 and 1 respectively.

The instrument was face validated by three experts, two from Department of Technology and Vocational Education and one from Department of Mathematics and Computer Education, all from Enugu State University of Science and Technology. They validated the instrument to ensure the appropriateness of the measuring instrument and that the instrument address the purpose of the study (Uzoagulu 2013). The comments of the validators were used to modify the final instrument used for data collection.

The reliability of the instrument was determined using Cronbach Alpha Coefficient and the reliability coefficient of 0.73 was obtained. A total of 52 copies of the questionnaire were distributed to the respondents with the help of three research assistants. The entire copies of the questionnaire were properly filled and returned and used for data analysis. The data were analyzed using mean and standard deviation to answer the three research questions while t-test was used to test the null hypotheses at 0.05 level of significance at the appropriate degree of freedom. The decision was based on the principle of lower and upper limit of the mean ,thus;

Strongly Agree (SA)	3.50 – 4.20
Agree (A)	2.50 – 3.49
Disagree (D)	1.50 – 2.49
Strongly Disagree (SD)	1. 00- 1.49

It was decided that the null hypotheses were rejected if the t-calculated values were equal to or more than the critical or t- table value but when the t-calculated values were less than the t- critical the null hypotheses were not rejected.

Result

The results obtained from the data analyzed are presented in tables below according to the research questions and hypotheses that guided the study.

Research Question 1

What are the environmental practices that could be used to enhance microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural zone?

Table 1: Mean scores and standard deviation of male and female extension workers on environmental practices that could be used to enhance microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural zone

S/N	**Environmental Practices to enhance microbial activities to improve vermicomposting include:**	**Male Extension workers N = 34**		**Female Extension worker N = 18**		**Overall**		**Decision**
		X1	**SD_1**	**X_2**	**SD_2**	**$\overline{XG}$**	**SDG**	
1	Maintain moisture of about 60-80% humidity	2.86	0.80	2.92	0.72	2.89	0.76	Agree
2	Ensure temperature between 15-25^{0}c	3.07	0.81	3.19	0.70	3.13	0.75	Agree
3	Maintain pH range of 6.5-7.5	3.09	0.84	3.24	0.72	3.16	0.78	Agree
4	Ensure adequate aeration	3.30	0.63	3.32	0.58	3.31	0.60	Agree
5	Maintain an optimal carbon to nitrogen ratio of about 25:1;30:1	3.23	0.69	3.29	0.63	3.26	0.66	Agree
6	Application of proper tillage to aerate the soil	3.21	0.59	3.26	0.55	3.23	0.57	Agree
7	Use of irrigation practices during arid periods	3.13	0.72	3.10	0.70	3.11	0.71	Agree
8	Reduction of bush burning to improve the life's of earthworms	3.79	0.41	3.77	0.42	3.78	0.41	Strongly Agree
9	Use coir to improve water retention and aeration	3.29	0.68	3.30	0.67	3.29	0.67	Agree
10	Reducing salt containing refuse	3.32	0.66	3.30	0.66	3.31	0.66	Agree
	Cluster Mean /SD	**3.22**	**0.68**	**3.26**	**0.63**	**3.24**	**0.65**	**Agree**

NOTE: X=Mean; SD=Standard Deviation

The analysis on Table 1, research question 1, revealed that the average mean of 3.24 signifies that the item statements are environmental practices that could be adopted to enhance microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone. The analysis shows that the overall mean scores for item number 8 is 3.77 which is above 3.50 depicting strongly agree. The low standard deviation of 0.65 indicates that the respondents have similar opinion to the items.

Hypothesis 1

There is no significant differences in the mean score of male and female extension workers on the environmental practice that could be used to enhance microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone.

Table 2: Summary of t-test analysis of mean score of male and female extension workers on environment practices that could be used to enhance microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone

Variables	*N*	*Mean*	*t*	D*f*	*(sig. 2tailed)*	*Mean difference*	*Std. error difference*	*Decision*
Male extension workers	34	3.22	.737		.462	.38528	.52303	NS
				52				
Female extension workers	18	3.26						

The result of t-test analysis in Table 2, shows that the t-value at 0.05 level of significance and at 50 degree of freedom for the 10 items is 0.737 with the significant value of 0.462. Since the significant value of 0.462 is more than 0.05 level of significance, the null hypothesis is not significant. This means that there is no significant difference regarding the items on male and female extension workers on the environmental practices used for enhancing microbial activities to improve vermicomposting for increased soil fertility in Enugu agricultural zone.

Research Question 2

What are the farmer's practices that can be used to enhance microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone?

Table 3: Mean scores and standard deviation of male and female extension workers on farmer's practices that can enhance microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone

S/N	*Farmers practices for enhancing microbial activities to improve vermicomposting include:*	*Male Extension workers N= 34*		*Female Extension Workers N= 18*		*overall*		*Decision*
		$\overline{X}$	SD_1	X_2	SD_2	$\overline{XG}$	SDG	
11.	Farmers adding bulky agents like straw, wood-chips will improve aeration for enhance vermicomposting	3.56	0.53	3.39	0.59	3.47	0.56	Agree
12	Farmers mixing compost piles to promote uniform decomposition	3.37	0.58	3.41	0.55	3.39	0.57	Agree
13	Turning compost regularly to promote fast and uniform decomposition	3.36	0.79	3.52	0.71	3.44	0.75	Agree
14	Monitoring the temperature and Ph levels	3.29	0.74	3.45	0.82	3.37	0.78	Agree
15	Adjusting temperature through irrigation to maintain optional condition	3.49	0.54	3.35	0.56	3.42	0.55	Agree
16	Introducing beneficial micro-organism to enhance decomposition and fasting vermicomposting	3.39	0.67	3.42	0.64	3.40	0.65	Agree
17	Provide adequate food like fruits and vegetables to enhance vermicomposting	3.54	0.58	3.52	0.59	3.53	0.58	Agree
	Cluster mean (SD)	**3.42**	**0.63**	**3.43**	**0.64**	**3.43**	**0.63**	**Agree**

Data Presented in Table 3 indicates that the items overall mean rating ranges from 3.37 to 3.53 depicting Agree. This shows that the items are the farmer's practices for enhancing microbial activities to improve vermicomposting in Enugu Agricultural Zone. The overall cluster mean of 3.43 indicates agree. This implies that the itemized are the farmer's practices for enhancing microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone. The low standard deviation of .63 shows that the respondents' opinions do not differ remarkably to the itemized.

Hypothesis 2

There is no significant difference in the mean scores of male and female extension workers on the farmer's practices that can be used to enhance microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone.

Table 4: Summary of t-test analysis of mean scores of male and female extension workers on farmer's practices that could be used to enhance microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone

Variables	*N*	*Mean*	*t*	*Df*	*(sig. 2tailed)*	*Mean difference*	*Std. error difference*	*Decision*
Male extension workers	34	3.42	.178		8.71	.09361	.5256	NS
				50				
Female extension workers	18	3.43						

The result of t-test analysis in Table 3 shows that the t-value at 0.05 level of significance and 50 degree of freedom for the items is .178 with a significant value of 8.71. As the significant value of 8.71 is more than 0.05 level of significance, the null hypothesis is not significant. This means that there is no significant difference with respect to the items on the mean scores of male and female extension workers.

Research Question 3

What are the benefit of improving microbial activities to enhance vermicomposting for increased soil fertility in Enugu Agricultural zone?

Table 5: Mean score and standard deviation of Male and female extension workers on benefits of improving microbial activities to enhance vermicomposting for increased soil fertility in Enugu Agricultural Zone

S/N	*Benefits of improving microbial activities includes:*	*Male Ext. Workers N=34*		*Female Ext. workers N=18*		*Overall*		*Decision*
		X1	**SD 1**	**X2**	**SD2**	**$\bar{X}G$**	**SDG**	
18	Enhance decomposition of organic matter very fast and more efficient	3.09	0.61	3.06	0.64	3.07	0.63	Agree
19	Improve nutrient contents which result in a higher quality vermicomposting	2.96	0.76	2.94	0.79	2.95	0.78	Agree
20	Reduces odur through aerobic condition and environmental factors which can minimize smell associated with vermicomposting	3.16	0.65	3.15	0.69	3.15	0.68	Agree
21	Improve soil structure	3.41	0.49	3.44	0.50	3.43	0.49	Agree
22	Reduce environmental pollution	3.08	0.71	3.08	0.65	3.09	0.66	Agree
23	Increase crop yield	3.45	0.60	3.48	0.55	3.48	0.56	Agree

24	Enhance eco-system service	3.14	0.62	3.13	0.59	3.14	0.60	Agree
25	Increase carbon sequestration	3.07	0.66	3.11	0.62	3.10	0.63	Agree
26	Reduce greenhouse emission	3.73	0.45	3.74	0.44	3.74	0.44	Strongly Agree
	Cluster mean/SD	**3.23**	**0.62**	**3.24**	**0.61**	**3.24**	**0.61**	**Agree**

NOTE: X = mean; SD= standard deviation

Data presented in Table 5 indicate that the overall mean score for item 26 is 3.74 which depicts strongly agree. The remaining items overall mean score range from 2.95 to 3.48 depicting agree. The overall cluster mean scores of 3.24 indicated agree. This shows that the items are the benefit of improving microbial activities for enhancing vermicomposting for increased soil fertility in Enugu Agricultural Zone. The low standard deviation of 0.61 shows that the respondents have homogeneity in their responses to statements in the items.

Hypotheses 3

There is no significant difference in the mean scores of the respondents on the benefit of enhancing microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone.

Table 6: Summary of t-test analysis of mean score of male and female extension workers benefits of enhancing microbial activities to improve vermicomposting for increase soil fertility in Enugu Agricultural Zone

Variables	*N*	*Mean*	*T*	*Df*	*(sig. 2tailed)*	*Mean difference*	*Std. error difference*	*Decision*
Male extension workers	34		0.61		.952	0.3355	.525134	
				50				
Female extension workers	18							NS

The result of data analysis obtained from the t-test in Table 6 shows that the t-value at 0.05 level of significance and 50 degree of freedom for the items is 0.61 with a significant value of .952. Since the significant value of .952 is more than the 0.05 level of significance the null hypothesis is not significant. This means that there is no significant difference regarding the items on the mean score of male and female extension workers on the benefit of enhancing microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone

Discussion of Findings

The findings of the study on research question one showed that the statement item are the environmental practices for enhancing microbial activities to improve vermicomposting for increased soil fertility in Enugu Agricultural Zone. Some of the identified environmental practices include; maintaining moisture of about 60-80% humidity, ensure temperature between 15-25^{0C} maintain pH level of 6-5-7-5, ensure adequate aeration, reduce salt containing refuse among others. These findings were in consonance with Iwena (2020) who noted that microbial activities promote the decomposition of organic matter, promote the aeration of the soil, reduce high soil temperature, conserve soil moisture and help in mixing organic materials with soil. All these help to promote the fertility of the soil. Nnoka and Ndupu (2018) supported this by stating that microbial activities can be enhanced by adding beneficial microbes such as (Azotobacter) nitrogen fixing bacterial, incorporate diverse organic materials, add biochar to improve soil structure, choose suitable earthworm species such as Etsenia fetida, maintain optimal earthworm density to ensure efficient decomposition and vemicompost production. The findings of the study revealed that there was no significance disparity in the mean scores of male and female extension workers on the environmental practices for enhancing microbial activities to improve vermicomposting for increased soil fertility. This implies that the gender of the respondents did not have a significant impact on the observed differences in mean scores between the two groups.

The findings in research question two revealed the following as the farmers practice for enhancing microbial activities to improve vermicomposting, adding bulky agent like straws and wood chips, mixing compost piles to promote uniform decomposition, monitoring the temperature and pH levels, turning compost regularly to promote fast and uniform decomposition, introducing beneficial microorganisms to enhance decomposition and vermicomposting among others. The findings of the study were in line with Ozougwu (2024) who stated that farmers practice include; turning organic matters like plant residues and animal manure, planting cover crops to create favourable environment for microbes, adding composted animal manure to promote microbial biomass and activities, incorporating biochar into the soil to encourage microbial activities. Furthermore, the study indicated that there was no significant different in mean score of male and female extension workers on farmers practices for enhancing microbial activities in Enugu Agricultural zone. This implies that the responses of both did not impact the identified farmers practices aimed at enhancing microbial activities for improved vermicomposting.

The findings on research question 3 of the study also revealed the benefits of improving microbial activities as follow; enhanced decomposition of organic matters, improves nutrient content, improve soil structure, enhances eco-system service among others. This finding is in consonance with the view of Owolabi, Ajayi and Akintola (2018) who revealed that microbial activities are enhanced where the environment is cool with enough debris and compost. Also Iwena (2020) noted that crop cannot do well, unless there are enough organic matters, and these organic matters are enhanced by farmer's activities such as burying green manure and mulching which will be decomposed by earthworm. Further, the study indicated that there was no significant difference in the mean scores of both male and female extension worker on the benefit of improving microbial activities for improved vermicomposting for increased soil fertility. This implies that both respondents are homogenous in the responses.

Conclusion

The study determined the strategies for enhancing microbial activities to improve vermicomposting for increase soil fertility. It was carried out in Enugu state. Three research questions and three null hypotheses guided the study. The need for the study was that most agricultural land have been over used by farmers and chemical fertilizers are used for increasing the soil fertility which in no distance time degrade the soil. Therefore, there is need to determine ways of enriching the soil which include application of good environmental practices, enhancing microbial activities and improved farm activities. Farm activities can be improved by proper tillage incorporation of organic manure, appropriate soil conservation practices among others. The study concluded that if all these activities are carried out, there will be increase in soil fertility.

Recommendations

Based on the findings of the study, the following recommendations were made.

1. Farmers should make the soil environment conducive to enhance decomposition of organic matter for fast vermicomposting
2. Proper soil conservation practices should be maintained
3. Farmers should adopt good farming practices to enhance vermicomposting

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