Empowering the Green Economy with Innovative Biopori Solutions

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Abstract. Consumption increases lead to an increase in waste output. Pollution must be avoided by recycling. Although household garbage has economic potential, its usage is hampered by a lack of information. The purpose of this study was to evaluate the community of Panggungharjo Bantul, Indonesia, with regard to their knowledge, utilization, and attitudes towards the current organic waste management system. Finding a relationship between respondent characteristics and organic waste management techniques is another goal of the study. Following a community service program, a questionnaire survey was employed in the study. An instrument that had been validated and self-administered was used to survey the thirty-two houses, after which the data would be examined. The results of this study indicate that following the training, there was a rise in public awareness and knowledge of organic waste management, and biopore technology. The households were willing to employ biopore technology and were aware of the current program for managing organic waste. The program's capacity to handle organic waste from homes will help the green economy by creating compost and maybe boosting GDP. It seeks to advance sustainable development, raise community knowledge of the value of environmental sustainability, and offer immediate social and economic advantages.

1 Introduction

Increasing global awareness about the importance of environmental sustainability has triggered various initiatives and innovations in order to empower the green economy [1]. The green economy itself is a concept that emphasizes balanced economic growth with environmental protection and social welfare [2,3]. The goals of the green economy are to lower carbon emissions, improve resource efficiency, and shield the environment from harm [4]. For this reason, a "green economy" prioritizes raising human well-being via sustainable resource management in addition to economic growth [5]. This strategy becomes essential to maintaining a balance between economic interests and environmental conservation in an era of increasingly severe climate change [6].

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Indonesia, as a country with abundant natural wealth, faces significant environmental challenges [7]. Among the primary environmental problems that require immediate attention are deforestation, land degradation, flooding, and declining water quality [8,9]. These circumstances are being made worse by climate change, which is making natural disasters and weather instability more common [10,11]. One of the most crucial environmental problems currently is the problem of waste, especially waste production in Yogyakarta, which is increasing every day along with the increase in the number of products and people's consumption patterns [12]. The population growth and swift economic progress have prompted a spike in the consumption of diverse goods and services, leading to an increase in waste production [13,14]. Improper management of household, industrial, and commercial waste not only results in health and aesthetic issues but also negatively affects the environment by increasing greenhouse gas emissions and contaminating the water and land. Therefore, solutions are needed that are not only environmentally effective but also widely applicable and sustainable [6,7].

One innovative solution that is starting to get attention is the application of biopore technology [17]. Biopori technology is one of the most promising innovations for facing these environmental challenges [18]. Small holes called biopores are created in the soil to improve soil quality, decrease puddles, and boost water infiltration [19,20]. This technique was originally introduced by Dr. Kamir R. Brata from the Bogor Agricultural Institute (IPB) and has proven effective in increasing groundwater infiltration capacity and reducing the risk of flooding. To avoid environmental pollution, it is necessary to reprocess the waste [21]. One source that helps homes economically is domestic garbage [22,23]. Nevertheless, this is hindered by a lack of understanding and awareness regarding the usefulness and economic worth of household garbage [24,25]. This condition was found in Sorowajan Dukuh Glugo, Panggungharjo Bantul Regency, as a PKM partner. In order to raise the added value of household organic waste, this Community Partnership Program activity seeks to educate the public about the significance of environmental cleanliness and to empower the community. Currently, household waste sorting activities are being carried out in Sorowajan. This activity is carried out so that organic waste produced by each household does not cause pollution or even flooding if it is disposed of carelessly.

The Community Partnership Program aims to offer solutions by harnessing the potential of organic waste through biopore technology, fostering awareness to promote a cleaner, waste-free environment.The PKM partner is Dasawisma Lili, which is located in Sorowajan Dukuh Glugo, Panggungharjo, Bantul Regency. The contribution of this Community Partnership Program is: 1) a program to increase the added value of organic waste using biopore tools, which will be donated by the PKM Proposing Team; 2) training on the use of biopore. By utilizing the potential of household waste through the above program, it is hoped that it can create a creative economy for the community by producing compost so that it can increase the income of the local community. In addition to raising public awareness about environmental conservation, it provides tangible benefits to individuals' social and economic well-being while contributing to sustainable development.

2 Methodology

2.1 Study site

This research was conducted in Panggungharjo Bantul, Indonesia, and observations revealed that effective management of potential organic waste requires collaboration with local human resources. By transforming this waste into compost through biopore technology, we can create value-added products while also empowering the community by involving them in the planning, management, and expression of their opinions.

2.2 Survey design and administration

To gain insights into how residents in the study area manage their organic waste, we surveyed local households. Using the Slovin equation, we determined the household sample size for this investigation, applying a 10% margin of error. Consequently, 32 households were chosen according to this calculation. Stratified random sampling was used to ensure representation from various economic strata, resulting in a cohesive sample of households.

The final survey questionnaire is divided into five sections. **Part A** focuses on collecting socio-demographic information, including respondents' age, marital status, education level, and income. **Part B** evaluates the household's knowledge of waste management, particularly their understanding of waste sorting practices. **Part C** investigates the facilities available for waste management within households, such as the existence of solid waste banks and access to 3R training programs. **Part D** assesses the activities households engage in regarding waste management, including their participation in relevant practices and their willingness to sort waste. Finally, **Part E** examines the use of waste management technology, concentrating on knowledge of biopore technology and the readiness to implement it.

Table 1. List of predictor variables along with the measurement scale for each variable.

Predictor	Scale	Predictor	Scale
Socio-demographic attributes of the households.		Household amenities associated with waste management.	
Age (X1)		Availability of waste bank (X6)	
<30	1	Not available	1
31-40	2	Available	2
41-50	3		
>50	4	Availability of training program on 3R (X7)	
Marital status (X3)		Not available	1
Married	1	Available	2
Unmarried	2	Household's activities to manage the waste	
Education level (X2)		Activities of waste management (X8)	
Elementary School	1	Manage	1
Junior High School	2	Doesn't manage	2
Senior High School	3	Technology of waste management	
Bachelor/Undergraduate	4	Knowledge of the biopore technology (X9)	
Income (X4)		No knowledge	1
Low	1	Sufficient knowledge	2
Middle	2	High level of knowledge	3
High	3	Willingness to apply the biopore technology (X15)	
Household's knowledge related to biopore		Willing	1
Knowledge in organic waste management (X5)		Not willing	2
No knowledge	1		
Sufficient knowledge	2		
High level of knowledge	3		

2.3 Data Analysis

To verify the relationship between predictor factors and response variables, a chi-squared correlation test (χ^2) was conducted using the SPSS program. Respondent variables related to community activities in utilizing biopore technology were assessed using two nominal scales. The first aspect evaluates the application of this technology to enhance the value of organic waste (Y): respondents' activities involving biopore technology for organic waste are classified as follows if biopore technology is not utilized, Y = 2; if it is used, Y = 1. Table 1 provides an overview of the predictor variables. The correlation between response and predictor variables is determined based on the following hypotheses:
1. Hypothesis (H0) is accepted if no association exists between the predictor variable (X) and the response variable (Y).
2. Hypothesis (H1) is accepted if a connection is found.

Pearson χ^2 values and significance levels (α) were utilized to determine the relationship between the response and predictor variables. The procedure for analyzing these correlations is outlined as follows:
1. If the calculated Pearson χ^2 value exceeds the table value, or if the calculated significance level is below 0.1, this indicates a correlation between the predictor and response variables (leading to the rejection of H0 and acceptance of H1).
2. Conversely, if the calculated Pearson χ^2 value is less than the table value or the significance level exceeds 0.1, this suggests no correlation exists between the predictor and response variables (resulting in acceptance of H0 and rejection of H1).

3 Results and Discussion

3.1 Socio-demographic of community

A total of 32 members of respondents have filled out the questionnaire. The results of the questionnaire will be explained further. The following are the results of filling out the questionnaire before and after the biopore-making training:
Based on gender, all members of respondents are female.

Table 2. Proportion of partner members by gender

Gender	**Total**	**Percentage (%)**
Female	32	100
Male	0	0
Total	32	100

In terms of age distribution, 9.4% of respondents were under 30 years old, while 15.6% fell within the 31-40 age range. Additionally, 43.7% of respondents were aged 41-50, with the remaining participants being over 50 years old.

Table 3. Proportion of partner members by age

Age	**Total**	**Percentage (%)**
<= 30 years	3	9,4
31-40 years	5	15,6

Age	Total	Percentage (%)
41-50 years	14	43,7
>50 years	10	31,3
Total	32	100

Based on marital status, 87.5% of respondents members are married and the remaining 12.5% are unmarried.

Table 4. Proportion of partner members categorized by marital status.

Marriage status	Total	Percentage (%)
Not married	4	12,5
Married	28	87,5
Total	32	100

The majority of respondents have completed their education at the junior high school or equivalent level, accounting for 47.6%. Meanwhile, 38.1% have graduated from high school or an equivalent program, while the remainder have completed elementary school or other levels of education.

Table 5. Proportion of partner members categorized by educational attainment.

Education	Total	Percentage (%)
Elementary School	1	4,7
Junior High School	15	47,6
Senior High School	14	38,1
Vocational School	0	0
Bachelor Degree	0	0
Post graduate Degree	0	0
Other	2	9,6
Total	32	100

There are 37.5% of respondents members who have certain skills/expertise, while 62.5% do not yet have skills/expertise.

Table 6. Proportion of partner members based on skills/expertise

Skills	Total	Persentage (%)
Do not have skills	20	62,5
Own skills	12	37,5
Total	32	100

Based on business ownership, the proportion of respondents members who own a business and those who do not own a business is 84.4% each.

Table 7. Proportion of partner members based on business ownership

Business Ownership	Total	Percentage (%)
Do not have effort	27	84,4
Owning a business	5	16,6
Total	32	100

With this PKM program, the knowledge of PKM partners, namely respondents, has increased. Initially, 76.2% of respondents did not know about biopori and how to make it, and 23.8% had only heard about it but did not know what it could be used for. After this program, 31.2% of respondents members knew about it but did not use it, and 62.5% have used it in economic activities.

3.2 Organic waste management

Table 8. Proportion of partner members based on knowledge about biopori

Knowledge about biopers	Before the Program		After the Program	
	Total	Percentage (%)	Total	Percentage (%)
Don't know yet	23	76,2	0	0
Just heard but don't know what yet which can be utilized	5	23,8	2	6,3
Already know but don't use it	4	0	10	31,2
Already know and have used it	0	0	20	62,5
Total	32	100	32	100

As many as 15.6% of respondents members originally hoped to practice making biopores and then sell the compost. After the PKM program, they want to practice and later be able to mass produce (25%) and they want to make it for themselves or their family (62.5%).

Table 9. Proportion of partner members based on PKM partner expectations

Expectations	Before the Program		After the Program	
	Total	Percentage (%)	Total	Percentage (%)
Want to practice and later sell the compost	5	15,6	1	3,1
Want to practice and later be able to make it for yourself or your family	15	46,8	20	62,5
Want to practice and later be able to mass produce compost	7	21,8	8	25
Want to practice and later employ people to produce compost from biopori	5	15,8	3	9,4
Total	32	100	32	100

With the existence of this PKM program, initially 16.6% of respondents members stated that the PKM program was useful, after the program was implemented almost all of them (96.8%) stated that the PKM program was useful.

Table 10. Proportion of partner members based on perceptions of the benefits of the PKM program

Benefit of PKM	Before the Program		After the Program	
	Total	Percentage (%)	Total	Percentage (%)
Not Useful	27	84,4	1	3,2
Useful	5	16,6	31	96,8
Total	32	93,3	32	100

3.3 Correlation between the respond variables and the predictor variables

Table 11 illustrates that community engagement in biopore technology can significantly enhance the value derived from plastic waste, particularly in relation to socio-demographic factors such as age, marital status, education level, and income. Additionally, it highlights the importance of knowledge in waste management, including understanding organic waste practices, access to facilities like waste banks and 3R training programs, and involvement in waste management activities. The training programs not only educate the public about the significance of sorting organic waste but also provide methods to do so, aligning effectively with the biopore technology training initiatives [29,30]. These findings are consistent with earlier research, which indicates that regular training programs can effectively enhance waste separation practices among waste generators [31]. The test findings also showed a correlation between the management of organic waste and one's understanding of and proficiency with biopore technology, which raises the organic waste's added value. The utilization of biopore technology and the existence of waste banks are related. This would suggest that the community with the waste bank agreed to handle household organic waste management in part by utilizing biopore technology.

Table 11. Results of the χ^2 correlation test examining the relationship between individuals who utilize biopore technology for organic waste management and the predictor variables.

Predictor variables	df	χ^2 values	Results
Age (X1)	1	16.246	Reject H0
Education level (X2)	1	20.622	Reject H0
Marital status (X3)	1	11.130	Reject H0
Income (X4)	1	14.098	Reject H0
Knowledge in organic waste management (X5)	1	6.619	Reject H0
Availability of waste bank (X6)	1	14.593	Reject H0
Availability of 3R training program (X7)	1	7.846	Reject H0
Activities of organic waste management (X8)	1	8.669	Reject H0
Knowledge in the biopore technology (X9)	1	12.308	Reject H0
Willingness to apply the biopore technology (X10)	1	14.345	Reject H0

4 Conclusions

Overall, this PKM activity went well. With training in making biopores, members of the Dasawisma Lily community group can increase their capacity to make compost by utilizing the potential of organic waste from households to reduce household waste and use the compost for plants. Based on the results of the questionnaire, Dasawisma Lily members experienced increased knowledge about biopori. They felt the benefits of training in making biopori and hope to be able to practice it themselves to utilize their household organic waste. This PKM activity is felt to provide enormous benefits for Dasawisma Lily in particular and the people of Dukuh Glugo and Panggungharjo in general, so they hope for the continuation of this PKM program.

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