

Cultivation of Cassava and Moringa Based on Ecoenzymes as an Effort to Prevent Stunting in Dry Land Areas

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Abstract. *The use of ecoenzyme-based solutions (EE) is one innovation in supporting sustainable food security in drylands. This research and community service project was conducted in Putukrejo Village, Kalipare District, Malang Regency, with the aim of increasing the productivity of cassava and moringa plants while supporting stunting prevention. Ecoenzymes were obtained from the fermentation of household organic waste, brown sugar, and clean water fermented for three months. The solution was applied to cassava and moringa at a dose of 15 per tree dissolved in one liter of water, applied weekly. The results showed an increase in the vegetative growth of moringa and cassava compared to the control group. From a socio-economic perspective, this technology improves the community's skills in production and opens up business opportunities for cassava and moringa-based food products. These findings are in line with the achievement of SDGs 2 (Zero Hunger) and SDGs 12 (Responsible Consumption and Production).*

Keywords: *Cassava, Drylands, Ecoenzyme, Moringa, Stunting*

INTRODUCTION

Stunting is a public health problem that has a long-term impact on the quality of human resources. Putukrejo Village in Kalipare District, Malang Regency, faces nutritional challenges due to limited nutritious food sources in drylands. The region's dry agroecological conditions limit water availability and soil fertility, reducing food productivity. Sweet potatoes and moringa were selected as priority commodities because they are highly resistant to drought and have important nutritional content for stunting prevention (Winarno, 2018). One of the main obstacles in agricultural development in drylands is the minimal use of organic fertilizer and high dependence on chemical fertilizers. Ecoenzyme solutions made from fermented household organic waste offer an environmentally friendly, inexpensive, and easy-to-produce solution for rural communities (Nurliah *et al.*, 2022). This innovation not only improves soil quality and crop productivity but also helps with sustainable organic waste management. Applying ecoenzymes to cassava and moringa can increase productivity and improve household nutrition. This approach also strengthens food self-sufficiency among rural communities.

This program also supports the achievement of *Sustainable Development Goals* (SDGs) number 2 (*Zero Hunger*) and number 12 (*Responsible Consumption and Production*), which emphasize the importance of nutritious food availability and environmentally friendly production patterns. However, studies on the application of ecoenzymes to drought-tolerant crops such as cassava and moringa remain limited, especially under dryland conditions with low organic matter content. This study aims to evaluate the effect of ecoenzyme application on the vegetative growth of cassava and moringa in dryland areas, assess the community's perception and utilization of these crops for stunting prevention, and analyze the potential of ecoenzymes to enhance soil fertility and water retention. The application of ecoenzymes significantly increases cassava and moringa growth performance and community awareness of nutritional food production compared to conventional cultivation.

LITERATURE REVIEW

Drought is the biggest problem faced by the community of Putukrejo Village, Malang Regency. According to local agricultural data, average rainfall in Putukrejo is less than 1500 mm per year, making it prone to seasonal drought. Plants respond to

environmental stress through physiological and anatomical changes, including the root system. In addition, during drought conditions, plant roots can undergo elongation or growth deeper into the soil to access groundwater. Plants that are able to survive in drought conditions tend to have roots that undergo high lignification, which serves to strengthen the tissue and prevent damage due to water stress. This shows the importance of structural adaptation in maintaining root function under environmental stress (Mendrofa and Lase, 2025).

The application of ecoenzymes is one solution to improve growth quality, enhance physical, chemical, and biological properties, and reduce the use of NPK fertilizers on plants. Ecoenzymes are liquid organic fertilizers that influence plant productivity and nutrient content. In the study by Kurniawan *et al.* (2024), ecoenzymes showed a significant effect on water content, wet weight, and protein and iron content. This confirms that ecoenzymes can improve plant nutritional quality while being environmentally friendly as an alternative to chemical fertilizers. Their enzyme content aids in the organic decomposition process to increase plant productivity (Ningrum *et al.* 2024). Ecoenzymes can be considered environmentally friendly because they are complex organic solutions produced from the fermentation of organic waste that can be used as organic fertilizers. The application of ecoenzymes also helps improve soil structure, maintain water availability, and provide the necessary nutrients so that plants are more resistant to drought stress. This improvement plays a crucial role in enhancing plant resilience in dryland ecosystems (Salsabila, 2023).

Ecoenzymes are beneficial for improving the physical properties of soil. By enhancing soil porosity and aeration, they create a more favorable environment for root growth and microbial activity (Viza, 2022). Ecoenzymes contain microorganisms that can increase the decomposition activity of organic matter, improve soil fertility, and increase plant production. The presence of these beneficial microbes supports nutrient cycling and contributes to long-term soil health (Abdul Gani *et al.*, 2022). Ecoenzymes are applied as liquid organic fertilizer at a dose of 15 ml dissolved in 1 liter of water, then watered at the base of the plant at a concentration of 300 ml per plant every week. This standardized application method ensures consistent nutrient delivery and enhances nutrient absorption efficiency (Kurniawan *et al.*, 2024). Therefore, the use of ecoenzymes not only supports soil fertility and sustainable plant growth but also

provides a practical and environmentally friendly alternative to conventional fertilizers, especially for dryland farming systems.

In addition to the application of ecoenzymes, watering time also affects plant growth. When planting in the morning, the air and soil conditions are still moist, so the plants do not dry out. Shading also affects the intensity of drought experienced by plants, which is also a determinant of successful plant growth. Other determinants of successful plant growth are the intensity of light, temperature, and humidity of the environment (Cahyarani *et al.*, 2024). Ecoenzymes contain active microbial and enzymatic compounds such as amylase and protease that accelerate organic matter decomposition and improve soil nutrient cycling.

RESEARCH METHODS

Moringa is planted using stem cutting in yards or used sacks. The main materials are healthy moringa cuttings taken from parent plants that are more than one year old, planting media consisting of loose foil mixed with organic fertilizer, and water for regular watering. Cassava was planted using young stem cuttings, which were planted with the lower part of the stem bent into a “V” shape at a depth of 5-10 cm in land that had been cultivated and treated with organic fertilizer as a soil conditioner. Maintenance was carried out through regular watering, weeding, and the addition of organic fertilizer to optimize growth. The election of moringa and cassava as the main commodities is based on their high nutritional content, especially protein, iron, vitamins, and energy, which are important for supporting stunting prevention. Both plants are highly adaptable to dry land, so they can be cultivated by rural communities as a source of nutritious food. Cassava provides carbohydrate energy, while moringa supplies essential proteins and micronutrients, making their combined cultivation complementary for addressing local malnutrition.

Ecoenzymes are applied to plants by dissolving 15 ml of ecoenzymes in 1 liter of clean water, then applying 300 ml of the solution to each plant. The planting media used are yards and used sacks planted with moringa and cassava. Ecoenzymes are applied by watering directly at the base of the plant every week, so that nutrients, enzymes, and beneficial microbes can be absorbed by the roots. This process is expected to increase the availability of nutrients in the soil, improve fertility, and strengthen the plants' resistance to environmental stress. Ecoenzymes also function as bioactivators that helps

soil microbial activity, resulting in healthier and more productive plant growth. The application of this method allows moringa and cassava plants to grow more optimally, produce high biomass, and yield harvest that serve as a nutritious food source to support stunting prevention in communities.

RESULTS AND DISCUSSION

1. Cassava and Moringa Growth Rate

The percentage of cassava and moringa plants growing in the yard illustrates the ratio of plants that survived to the total number of plants planted during the observation period. Changes in the number of living and dead plants were observed weekly to determine the percentage if successful growth. Figure 1 and 2 present data on the number of living and dead cassava and moringa plants, as well as the percentage of growth during the observation period.

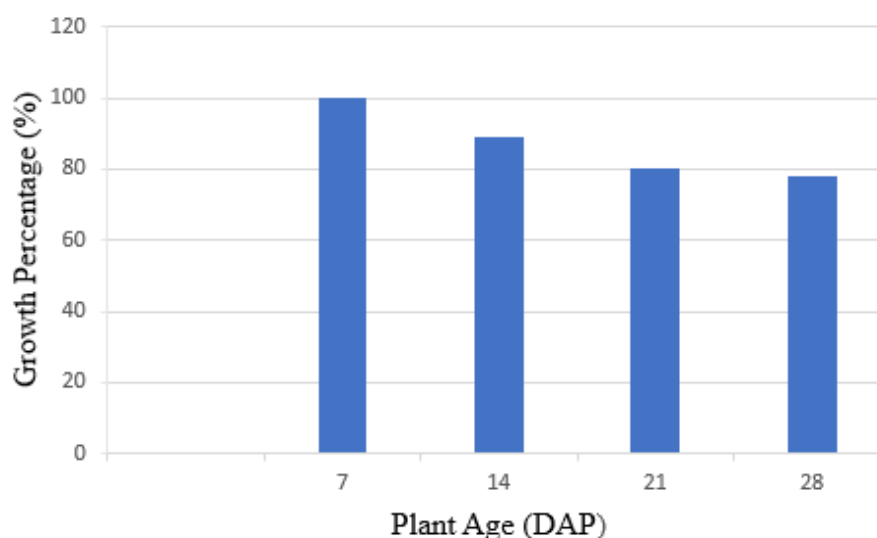


Figure 1. Growth percentage of cassava plants

Observation of 45 cassava stem cuttings showed a decrease in the number of surviving plants from week to week. In the first week (7 days) after planting, all seedlings grew well, resulting in a 100% survival rate. However, in the second week, the number of surviving plants decreased to 40 (88.9%). In the third week, the number decreased again to 36 plants (80%), and in the fourth week, only 35 plants survived with a growth rate of 77.8%. This decline was caused by environmental factors, particularly excessive sun exposure without shade during the early growth phase (Ningrum *et al.*, 2024). These conditions reduced soil moisture and caused young seedlings to dry out,

resulting in the death of some of them. Limited water availability during the dry season also exacerbated these conditions. Nevertheless, a growth success rate of over 75% still indicates that cassava is quite adaptive to the conditions in Putukrejo Village and is suitable for development on a home garden scale.

The cassava growth percentage Figure shows a downward trend in the number of living plants as the plants age from the first week to the fourth week. Seven days after planting (DAP), the growth percentage reached 100%, but dropped to 88.9% in the second week, and 77.8% in the fourth week. This decline is closely related to environmental conditions in the field, where some newly planted plants were exposed to direct sunlight without shade, causing soil moisture to decrease rapidly (Cahyarani *et al.*, 2024). This lack of moisture caused the plants to experience drought in the early stages of growth, causing some seedlings to wither and die. However, the Figure also shows that most plants were able to survive and grow well. This is thought to be due to the application of ecoenzymes as liquid organic fertilizer at a dose of 15 ml dissolved in 1 liter of water, which was then sprayed on the based of the plants at a concentration of 300 ml per plant every week (Kurniawan *et al.*, 2024).

Ecoenzymes derived from organic materials such as a fermented fruits and vegetables have a positive impact. The application of ecoenzymes helps improve soil structure, maintain water availability, and provide the necessary nutrients so that plants are more resistant to drought stress (Salsabila, 2023). Thus, this Figure shows that the success of cassava growth is not only determined by environmental conditions but is also significantly influenced by simple technological interventions such as the use of ecoenzymes in backyard cultivation. For moringa plants, the growth percentage is shown in Figure 2, which was observed during the observation period.

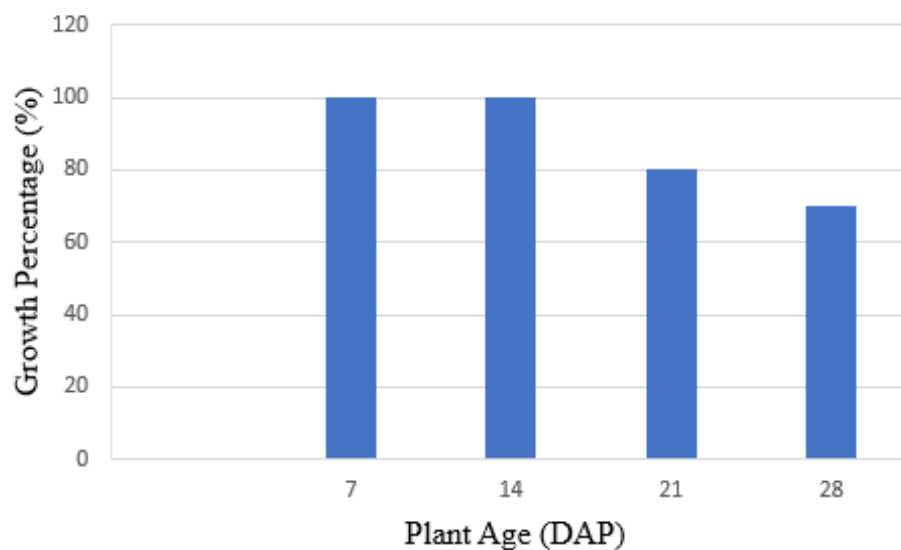


Figure 2. Growth percentage of moringa plants

The growth rate of moringa in the yard shows fairly good initial success, with 100% of plants surviving in the first two weeks, then decreasing to 80% in the third week and 70% in the fourth week. This decline was influenced by environmental factors such as a lack of organic matter, insufficient light, and irregular watering, although most plants were still able to survive. This indicates that moringa has a high adaptability, but more consistent care is needed to increase the success rate to above 80%. This can also be seen in the following Figure.

Observation of ten moringa plants in the yard showed differences in survival rates over the four-week period. In the first week, all plants were still alive, indicating that the initial planting process was carried out quite well. The plants looked fresh because they still had energy reserves from the stem cuttings used. This is in line with the opinion of Gulo and Waruwu (2024) that roots that are unable to penetrate compact soil will have difficulty absorbing water nutrients. This condition worsened when the water supply decreased due to the prolonged dry season. Irregular watering made the plants more susceptible to death. According to Rafi *et al.* (2023), young plants or plants in the vegetative stage require extra care in the early stages of growth. Lack of attention during this critical period resulted in two plants being unable to survive.

The application of ecoenzymes had a positive impact on the vegetative growth of moringa and cassava, with leaves that were more lush, dense, and formed more quickly than the control. These results prove that ecoenzymes can improve soil fertility, increase

plant biomass, and support productivity even in dry areas. In line with Salsabila *et al.* (2023) ecoenzymes also function as organic liquids to maintain soil fertility, stimulate root growth, and increase plant resistance. In addition, this program provides new skills for the community on processing organic waste into liquid fertilizer, reducing dependence on chemical fertilizers, while also opening up economic opportunities through value-added products such as moringa tea and healthy cassava products.

2. Public Perception of Cassava and Moringa

Based on the questionnaire distributed to respondents, a general picture was obtained regarding the perceptions and habits of the Putukrejo Village community related to moringa and cassava plants. This data includes information on the presence of moringa and cassava in yards, the parts of the plant that are consumed, seed sources, planting distances, and the care methods used. In addition, the questionnaire also contained respondents' knowledge about the benefits of moringa and casava, the types of processed products commonly made, the size of the yard, and other food crops owned. These results are important for understanding the level of moringa and cassava utilization in the community as well as identifying its development potential. A summary of the respondents' answers can be seen in the following table.

Table 1. Results of the Putukrejo Village Community Questionnaire on Cassava.

No.	Question	Answer	Percentage (%)
1.	Are there any cassava plants in the yard?	Yes / No	65 / 35
2.	Which part of the cassava plant is usually consumed?	Leaf / Flower and Leaf	70 / 30
3.	Where did the cassava seeds came from?	Stems cutting / Purchase / Neighbor's Gift	65 / 5 / 30
4.	What type of fertilizer is used in cassava cultivation?	Manure / NPK / No Fertilizer Used	55 / 30 / 15
5.	What products are made from cassava?	Chips / sweet potato compote / sweet potato cake / others	40 / 15 / 15 / 30
6.	Do you know about the benefits of cassava?	Yes / No	70 / 30
7.	How old are the respondents?	< 30 years / 30-45 years / > 45 years	25 / 60 / 15
8.	What is the size of the yard?	≤ 50 m ² / > 50 m ²	65 / 35
9.	What other edible plants are there in the yard besides cassava?	Avocado, chocolate, cassava, banana, katu, dragon fruit, taro, banana, chili, lamtoro, coffee, longan, avocado, matoa, jackfruit, and coffee	

Based on Table 1, the results of the questionnaire distributed to residents provided an overview of the habits, level of knowledge, and use of cassava plants in daily life. The data shows that 65% of respondents stated that they had cassava plants in their yards, while the other 35% did not grow them. This indicates that most people are actually familiar with cassava as a food crop and have experience growing it, although there are still some residents who do not utilize it, most likely due to limited yard space or a lack of awareness of the nutritional value of this plant.

In terms of plant part utilization, the majority of the community (70%) only consumes the tubers, while the other 30% utilizes both the tubers and young cassava leaves as vegetables. This finding indicates that the utilization of cassava plants in Putukrejo Village is still limited to common products, namely tubers as a source of carbohydrates. However, cassava leaves are known to be rich in protein, vitamins, and minerals that are beneficial for health, especially in preventing stunting. The low utilization rate of cassava leaves indicates the need for further socialization and education so that the community realizes the nutritional potential of all parts of the cassava plant, not just the tubers.

When viewed from the source of the seeds, most of the community (65%) obtained seeds through stem cuttings from plants they owned, 30% from neighbors, and only 5% bought seeds at the market. This shows that the availability of cassava seedlings is not actually a major obstacle in the village, as there is already a tradition of sharing among residents and a tradition of propagating plants independently. In terms of maintenance, 55% of the community uses manure, 30% uses NPK fertilizer, and 15% does not use fertilizer at all. This finding shows that the majority of residents prefer simple cultivation methods using easily obtainable organic fertilizer, although a small portion still do not fertilize, resulting in suboptimal plant growth.

When it comes to processed products, people's perceptions are still dominated by sweet potato chips as the main processed product, with 40% of respondents mentioning this product as the most frequently made processed product. Additionally, 15% of respondents mentioned sweet potato compote, 15% mentioned sweet potato cake, and 30% mentioned other products such as boiled sweet potatoes, steamed sweet potatoes, and simple snacks. This shows that the community is accustomed to processing sweet potatoes into everyday foods, but the variety of processed products is still relatively

limited. Diversification of cassava-based processed products is still very much needed so that the public not only becomes familiar with traditional products but also begins to utilize cassava for modern processed goods with higher economic value, such as cassava flour, cakes, or baby food based on cassava puree.

In terms of knowledge, 70% of respondents stated that they were aware of the nutritional benefits of cassava, while the other 30% were not yet fully aware of them. The high number of people who already have this knowledge shows that the extension program has succeeded in raising their awareness of the importance of sweet potatoes as a nutritious food. In line with the opinion of Putri *et al.* (2023), sweet potatoes have many benefits and nutritional content, where they can be used as an alternative source of carbohydrates. However, there are still groups of people who are not aware of their benefits, which is a challenge that must be overcome with continuous socialization activities, especially targeting groups that rarely participate in village activities, such as young people or the elderly. Based on the respondent profile in Figure 15, the majority of the community involved in the questionnaire were in the productive age range of 30–45 years (60%). The remaining respondents were under 30 years old (25%) and over 45 years old (15%). The dominance of the productive age group is highly advantageous because this group possesses relatively better physical strength, knowledge, and skills to implement cassava cultivation and processing. Meanwhile, in terms of yard area, 65% of respondents have small plots with an area of ≤ 50 m², while the remaining 35% have larger plots. This condition indicates that land constraints are one of the factors hindering the development of cassava, although there are already solutions such as cultivation using sacks or polybags that can be applied on small plots of land.

In addition to cassava, the community also grows various other types of consumption crops in their yards, such as bananas, avocados, cocoa, coffee, chili peppers, taro, jackfruit, and dragon fruit. This fact shows that the people of Putukrejo Village are accustomed to utilizing their yards as a source of food for their families. Thus, introducing cassava as an additional crop is not difficult, because culturally the community is already familiar with the concept of utilizing yard space. The perception of the Putukrejo Village community towards cassava is quite positive, where most residents are already familiar with it, grow it, and consume it. However, there are still limitations in terms of utilizing the leaves as a source of nutrition, diversifying

processed products, and the awareness of some members of the community regarding the overall nutritional benefits of cassava. Therefore, further education through posyandu cadres, farmer groups, and PKK mothers needs to be continuously carried out so that the community does not only view sweet potatoes as supplementary food but also as one of the main pillars of family food security and efforts to prevent stunting in the village.

Table 2. Results of the Putukrejo Village Community Questionnaire on Moringa

No.	Question	Answer	Percentage (%)
1.	Are there any moringa plants in the yard?	Yes / No	65 / 35
2.	Which part of the moringa plant is usually consumed?	Leaf / Flower and Leaf	90 / 10
3.	Where did the moringa seeds come from?	Stems cutting / Purchase / Neighbor's Gift	60 / 25 / 15
4.	What type of fertilizer is used in moringa cultivation?	Manure / NPK / No Fertilizer Used	55 / 30 / 15
5.	What products are made from moringa?	clear soup / moringa tea or other drinks	80 / 20
6.	Do you know about the benefits of moringa?	Yes / No	75 / 25
7.	How old are the respondents?	< 30 years / 30-45 years / > 45 years	25 / 60 / 15
8.	What is the size of the yard?	$\leq 50 \text{ m}^2$ / $> 50 \text{ m}^2$	65 / 35
9.	What other edible plants are there in the yard besides moringa?	Avocado, chocolate, cassava, banana, katu, dragon fruit, taro, banana, chili, lamtoro, coffee, longan, avocado, matoa, jackfruit, and coffee	

The questionnaire results showed that the majority of Putukrejo Village residents were familiar with moringa and most had this plant in their yards. The most consumed part of the plant is the leaves, with 90% of respondents using them as an everyday vegetable. This shows that moringa leaves have become a locally known source of nutrition. A small percentage of respondents, around 10%, consume the flowers in addition to the leaves, although their use is more limited and not as popular as the leaves. This data shows that public perception is still focused on one main part of the plant, even though all parts of moringa have potential benefits. The dominance of leaf consumption is also in line with literature that mentions the high protein, vitamin, and mineral content in moringa leaves. However, limited knowledge about other parts such as seeds indicates that there is room for improvement in terms of information. Some people still view moringa as just an ordinary plant with no added value beyond being an

additional vegetable. This perception limits the potential for developing moringa as a multifunctional nutritional source. Some respondents mentioned that moringa is considered a secondary plant because it is only consumed when available, not prioritized in daily meals. This situation indicates that although the community is aware of moringa, the intensity and sustainability of its utilization remain low. This limited understanding is a challenge in raising awareness of the importance of moringa as a nutritious food source.

The origin of the moringa seeds owned by respondents generally came from stem cuttings given by neighbours or family, with a percentage reaching 60%. Twenty-five percent of respondents obtained seeds by purchasing them from markets or local seed sellers, while the remaining 15% received them for free through assistance from students or village programs. This fact indicates a culture of mutual cooperation in the distribution of moringa seeds, which can accelerate the adoption process at the household level. However, differences in seed sources also lead to variations in quality, as not all seeds are of the same standard. Some respondents complained about slow growth or moringa that did not survive long, which may be influenced by seed quality. Regarding planting distance, most residents plant at a distance of 1–1.5 meters, though some plant without considering the ideal distance. Plant care also varied, with 55% using organic fertilizer, 30% using NPK chemical fertilizer, and 15% not using fertilizer at all. This variation indicates differences in the level of knowledge about proper cultivation techniques. Respondents who use organic fertilizer generally have better moringa growth than those who do not fertilize. According to Hartatik et al. (2015), organic fertilizer provides macro and micro nutrients in balanced amounts while increasing the organic content of the soil. This shows that knowledge and care practices have a significant effect on plant success. Some residents still believe that moringa can grow on its own without intensive care, so they pay less attention to soil fertility factors. This assumption causes problems when plant growth is not optimal, even though moringa can actually grow more productively if cared for properly.

Public perception of the benefits of moringa varies, with 75% of respondents claiming to know its health benefits, while the other 25% are not yet clearly aware of them. The majority of respondents who know the benefits of moringa mention that moringa leaves can increase stamina, help treat anemia, and improve toddler nutrition.

Some also mentioned that moringa is good for digestion and maintaining immunity, although this understanding is not yet widespread. This aligns with the opinion of Saputra et al. (2021) that the nutritional content of moringa leaves serves to meet the body's nutritional needs, so that nutritional balance is achieved by consuming them. Respondents who are unaware of moringa's benefits typically consume it rarely and only grow it due to local customs. The most common processed product is moringa soup, with 80% of respondents citing it as their family's favourite dish. A small portion, around 20%, process moringa into tea or other more innovative products. The limited variety of processed products makes moringa less appealing to some families, especially children who are reluctant to consume leafy vegetables. This indicates the need to develop more diverse processed products to make moringa consumption more routine and appealing. Other common backyard plants such as chili peppers, tomatoes, and cassava are often prioritized because they are considered more versatile. As a result, moringa is still considered a supplement, not a staple in daily consumption. In fact, if awareness of its benefits is expanded, moringa can become a major alternative for the prevention of stunting and improved family nutrition. This situation highlights a gap between knowledge and actual practice in the field. More in-depth education is needed so that the community not only knows the benefits of moringa, but also truly makes it an important part of their daily diet. This effort is important to increase the effectiveness of the MMD-DM program in maintaining food security and community health.

CONCLUSION

The application of ecoenzyme fertilizer on cassava and moringa has proven effective in enhancing plant growth in the dry fields of Putukrejo Village. This technology offers agronomic, social, and economic benefits while supporting efforts to prevent stunting through increased availability of nutritious food. With low production costs and easily obtainable raw materials, ecoenzymes have the potential to become a solution to support the effectiveness of sustainable organic fertilization that can be replicated in the other areas with similar conditions. Overall, this program has succeeded in having a positive impact on improving community nutrition awareness, yard utilization, and community-based empowerment. This activity not only supports the achievement of SDG 2 but also contributes to SDG 12 (Responsible Consumption and Production).

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