AMMA : Jurnal Pengabdian Masyarakat
Volume 5, No. 8 September (2026)
ISSN 2828-6634 (media online)
Hal 764-768

Utilization of Agricultural Waste as a Growing Medium Adapted to Extreme Climates

Adhitya Firdaus[1*], Atikah Sylfa Nabila[1], Ellysia Putri Regandra[1], Muhammad Ghifari[1], Nazwa Putri Andani[1], Abdul Hadi[1]

[1]Soil Science, Lambung Mangkurat University, Banjarbaru, Indonesia
Email : [1]tambalangkecil86@gmail.com
(* : coressponding author)

Abstract - Climate change has a major impact on agriculture, particularly food crops, meaning that without mitigation and adaptation efforts addressing rising temperatures, shifting rainfall patterns, and sea-level rise, the food agriculture sector will suffer massive losses. Furthermore, the threat of declining strategic food crop production is driven not only by climate change but also by inadequate reservoir and irrigation infrastructure, along with the ongoing, uncontrolled conversion of agricultural land to non-agricultural uses, which is further compounded by crop failures from extreme weather and pest or disease outbreaks. To address these challenges, efforts to reduce the risk of crop failure can be implemented through both structural and non-structural measures, developing diverse species and varieties resistant to climate stress, applying climate information, developing soil and crop management technologies to enhance plant adaptability, and developing farm business protection systems against losses caused by climate change.

Keywords: Climate Change, Plant Adaptability, Agricultural Waste

1. INTRODUCTION

The agricultural sector plays a crucial role in supporting national food security, providing industrial raw materials, and serving as a livelihood for the majority of the Indonesian population, particularly in rural areas. However, along with the increasing intensity of agricultural activities, environmental problems have also emerged due to the accumulation of waste from production by-products that are not properly managed. Agricultural waste such as rice straw, husks, corn stalks, coconut coir, bagasse, fruit peels, and leftover harvest leaves are generally left to rot in the fields or even burned, ultimately causing negative environmental impacts such as increased air pollution, reduced soil fertility, and decreased quality of agricultural ecosystems. Ironically, on the other hand, the organic matter contained in agricultural waste actually holds great potential for reuse as an alternative resource, especially as a useful and environmentally friendly growing medium (Sutanto, 2015).

The utilization of agricultural waste into growing media is an innovation that can support the principles of sustainable agriculture and development. So far, conventional seedling media used by farmers, such as topsoil, sand, and manure, often face various constraints. Fertile soil is increasingly limited in availability, manure requires a long decomposition time, and its repeated use has the potential to spread plant diseases due to contamination by pathogenic microorganisms (Wahyuni et al., 2018). In addition, the use of inorganic or chemical-based growing media, although capable of accelerating seedling growth, can cause long-term soil degradation and create a dependency on synthetic materials. Therefore, alternative seedling media sourced from natural and easily obtainable materials are needed, which can simultaneously reduce the volume of agricultural waste in the field.

Indonesia, as an agricultural country, faces dual pressures on its agricultural sector: on the one hand, the production of agricultural biomass waste continues to increase alongside rising food crop productivity, while on the other hand, the sector is increasingly vulnerable to extreme climate events. The potential of national agricultural waste—primarily rice straw, corn, soybeans, peanuts, and sweet potatoesis estimated to reach 51,546,297.3 tons of dry matter per year, with rice straw as the largest contributor (85.81%) (Jasmal, 2007). Meanwhile, the impact of extreme climate events on Indonesia's agricultural sector is felt more severely, not only due to the increasing intensity of these occurrences but also because of the rising vulnerability level of agricultural land (CCROM IPB, 2017). Changes in rainfall patterns, rising air temperatures, and increased frequency of floods and droughts are reported to hinder the achievement of national agricultural development targets

(Demak Regency Agriculture and Food Office, 2022), and rice production is even reported to drop by up to 20–30% in years with high drought intensity (Indonesian Ministry of Agriculture, in FKP UNESA Digital Agribusiness, 2026).

Various studies show that agricultural waste has the potential to be processed into growing media or soil amendments due to its high organic matter content, but most of this waste is still directly burned in the fields or utilized in a limited way as animal feed, so its potential as a growing medium has not been managed optimally and integratedly (Center for Agro-Socioeconomic Research and Development, in AgroCircle Griya, 2024). Meanwhile, agricultural adaptation efforts against extreme climates have largely focused on developing drought-resistant varieties and improving irrigation efficiency, whereas the utilization of agricultural waste as growing media specifically designed to enhance water retention capacity, stabilize media temperature, and improve root structure under climate stress conditions is still relatively rarely studied in an integrated manner.

2. RESEARCH METHODS

The outreach activities in the Community Service Program (KKN) are carried out in several stages, namely preparation, presentation of the material, and completion of a questionnaire.

a. Preparation phase

Creating a schedule for outreach activities and preparing the necessary tools and materials for the outreach session to be held in Tambalang Kecil Village, Hulu Sungai Utara Regency, South Kalimantan Province.

b. Presentation of the Material

The event was attended in person by farmers from the Mawar I, Mawar II, and Mawar III groups. Also in attendance were local residents, village officials, and students participating in the Community Service Program (KKN).

c. Filling Out the Questionnaire

The questionnaire was printed on HVS paper and filled out directly by the guests in attendance. In addition, face-to-face interviews were conducted, and discussions took place regarding the use of weeds as compost.

3. RESULTS AND DISCUSSION

3.1 Results

The change in respondents' perspectives on Utilization of Agricultural Waste as a Growing Medium are show in Table 1. The table indicates an increase in the percentage of respondents who are motivated to ultize agricultural waste as a growing medium that adapts to extreme conditions

Statement	Before	After	Changes
Learning about the use of agricultural waste	40%	80%	+40%
Practicing the use of agricultural waste as a growing medium	20%	60%	+40%
Attending an outreach event related to	28%	72%	+44%

The results in the table show a significant increase in respondents' knowledge and participation regarding the use of agricultural waste as a growing medium adapted to extreme

AMMA : Jurnal Pengabdian Masyarakat
Volume 5, No. 8 September (2026)
ISSN 2828-6634 (media online)
Hal 764-768

conditions. Before the activity took place, only 40% of respondents were aware of the use of agricultural waste, but after the activity, this figure rose to 80%, indicating a 40% increase in awareness.

In addition, the practice of using agricultural waste as a growing medium also increased from 20% to 60%, indicating a 40% rise in motivation and direct implementation. This reflects that the outreach and demonstration activities conducted successfully encouraged respondents to more actively utilize agricultural waste in practice.

Participation in extension activities or related events also increased from 28% to 72%, a 44% change. This increase indicates that the activities successfully sparked public interest in participating in sustainable agricultural waste management efforts. Overall, these data illustrate the program's success in enhancing public knowledge, practices, and participation regarding the environmentally friendly and climate-resilient utilization of agricultural waste.

Figure 1. Outreach Activities and Questionnaire Completion

According to the journal *Sinergi Dalam Pertanian Indonesia Untuk Mitigasi Dan Adaptasi Perubahan Iklim* (Masturi *et al*., 2021).

Mitigation and adaptation in agricultural solutions are primarily targeted at minimizing methane or nitrous oxide pollution or fostering soil energy accumulation. Nevertheless, these methods impact agroecosystem carbon or nitrogen cycles by affecting greenhouse gas (GHG) production and mineral cycling. Although certain mitigation measures may have detrimental effects on agricultural adaptation programs, other types of climate change adaptation solutions possess beneficial mitigation effect processes, such as channeling crop residues into fertile soil or introducing flexibility in crop rotation. Tolerance to increased temperature and precipitation fluctuations can help ensure higher production processes. This can be achieved by enhancing the capacity of surface water to transport and distribute mineral elements from the soil. This objective can be met by increasing the soil's water retention potential through the application of crop residues to fertile soil or by introducing flexibility into crop rotations. Synergies between mitigation and adaptation in the agricultural sector appear to offer broad opportunities. However, the relationship between mitigation and adaptation is not fully understood, and further research is expected in the future regarding the measurement of both short-term and long-term impacts of climate change adaptation and mitigation in the agricultural sector. New agricultural systems combining bioenergy and agricultural production systems need to be established to understand agriculture's maximum potential in facing climate change (Masturi *et al*., 2021)

3.1.1 Descriptive Analysis of Public Climate Literacy and Sensitivity

The results of the descriptive analysis reveal an absolute level of collective awareness regarding the global climate crisis, encompassing an understanding of global warming, extreme weather, and the greenhouse effect. Public perceptual sensitivity proves to be aligned with empirical climate change trends, as all respondents confirmed a rise in micro-temperatures over the past decade. In addition to thermal anomalies, this phenomenon is spatially articulated through the

degradation of physical environmental indicators (70%) and disruptions in the fluctuation and availability of water resources (30%).

3.1.2 Socio-Ecological Vulnerability and Agricultural Sector Analysis

The local level of vulnerability to hydrometeorological disasters is categorized as high, demonstrated by 90% of respondents recording a history of flood exposure over the past 20 years. The pattern of disaster impacts shows unevenly distributed vulnerability, with losses predominantly concentrated in the agricultural sector rather than the domestic sector. The negative implications of flooding mostly manifest as disruptions to land productivity, including technical planting difficulties due to post-disaster conditions (50%), total crop failure (30%), and disturbances in agricultural land water management (10%). Meanwhile, physical damage in the form of water infiltration into settlements (flooded houses) was experienced by only 10% of respondents, emphasizing that the local climate crisis directly impacts food security and community livelihoods.

3.1.3 Knowledge Transmission Effectiveness and Adaptive Capacity Building

The high cognitive understanding among the community regarding relatively complex ecological concepts (such as greenhouse gases) indicates the effectiveness of community-based climate communication strategies. University students play a dominant role as the primary knowledge transfer agents, accounting for 80%. Supplementary information channels are supported by agricultural extension institutions (10%) and digital convergence channels such as YouTube (10%). These findings prove that direct educational interventions through participatory engagement conducted by academics can bridge the information gap and strengthen the adaptive capacity of communities at the local level.

3.2 Discussion

The residents of Tambalang Kecil Village have shown a strong interest in efforts to reduce the impact of greenhouse gas (GHG) emissions. This is evident from their enthusiasm in participating in outreach sessions and discussions on the importance of preserving environmental quality. This awareness serves as a crucial foundation for driving concrete action at the local level, as the community is the primary actor directly interacting with agricultural land and natural resources. Armed with the knowledge they have gained, community members are beginning to understand that GHG emissions not only contribute to global climate change but also affect agricultural productivity and their own well-being.

Efforts to minimize GHG emissions can be made through the adoption of sustainable agricultural practices, such as the use of organic fertilizers, the utilization of agricultural waste, and more efficient water management. Rural communities have great potential to implement these mitigation strategies because they are already accustomed to traditional farming systems that are relatively environmentally friendly. With guidance from KKN students and academics, new knowledge about adaptive technologies can be integrated with local wisdom to produce solutions that are more effective and suited to village conditions.

In addition, the community's active involvement in efforts to mitigate the impacts of greenhouse gases also contributes to the creation of a culture of environmental stewardship at the community level. This collective awareness can strengthen the village's resilience against the threat of extreme weather events, such as floods and droughts, which are occurring with increasing frequency. Thus, Tambalang Kecil Village not only benefits from the awareness-raising program but also plays a leading role in safeguarding environmental sustainability. This initiative aligns with the global agenda to reduce GHG emissions and support sustainable development.

4. CONCLUSION

Overall, this initiative underscores that the synergy between mitigation and adaptation in the agricultural sector presents significant opportunities to enhance food security and environmental sustainability. By combining adaptive technologies, local knowledge, and institutional support, rural

communities can play a leading role in reducing GHG emissions while safeguarding agricultural productivity from the threats of climate change.

ACKNOWLEDGMENTS

We would like to express our gratitude to the residents of Tambalang Kecil Village for their active participation in the outreach and discussion sessions. The author also appreciates the support of village officials, the academic advisor, and the KKN students who helped make this event possible. All parties involved have made valuable contributions that ensured the success of this research and community service project.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest in this study. The entire research, analysis, and writing process was conducted independently, without any external influence. Thus, the results presented are based solely on scientific findings and academic objectives.

REFERENCES

IPCC. (2021). *Climate Change 2021: The Physical Science Basis*. Cambridge University Press.

Kementerian Lingkungan Hidup dan Kehutanan. (2020). *Strategi Nasional Pengendalian Emisi Gas Rumah Kaca*. Jakarta: KLHK.

Masturi, H., Hasanawi, A., & Hasanawi, A. (2021). Sinergi dalam pertanian Indonesia untuk mitigasi dan adaptasi perubahan iklim. *Jurnal Inovasi Penelitian*, *1*(10), 2085-2094.

Fadilah, A. N., Idrus, I. I., & Mappe, U. U. (2026). Food Security Strategies of Farmworker Households in Pa'batangan Village, Takalar Regency. *Jurnal Sosiologi Nusantara*, *12*(1), 57-76.