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Diffusion of Organic Agriculture Communication Innovations as an Effort to Mitigate Climate Change

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Muhamad Hidayat[1*], Deddy Irwandy[1], Achmad Hamudi Assegaf[1]

[1]LSPR Institute of Communication and Business
Jln. K.H. Mas Mansyur No. Kav. 35, Jakarta 10220 - Indonesia
[*]Corresponding author: m.hidayat@lspr.edu

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Abstract - The long-standing use of synthetic fertilizers and pesticides has created habits and dependency among farmers. Inorganic materials have become commonplace and it seems as if there are no other options to use as farming inputs. Basically, synthetic-based agricultural production materials can damage the environment and potentially harm farmers. Most farmers in the Subak Wengaya Betan Farmers Group have switched from using inorganic materials to organic ones up to now. This should serve as an example of how farmers in Subak Wengaya Betan can adopt organic farming innovations. This research aims to analyze the diffusion process of organic agricultural communication innovations as an effort to mitigate climate change in the Subak Wengaya Betan Farmers Group, Bali Province. The main process in qualitative research was chosen to obtain in-depth results through the data collection stage using interviews, observations, and other documentation to gather detailed information as data collection techniques.The results of this study indicate that effective steps that can be accepted by farmers to transition to organic farming include the development of a social system closely tied to local wisdom, along with the active participation of customary or village officials who possess and earn the trust of the community The results of this study highlights the integration of innovation diffusion with local cultural values as key to the successful adoption of organic farming and offers practical insights for climate-resilient agricultural communication strategies in Indonesia.

Keywords: **Keywords**: Diffusion of innovation; Communication; Mitigation; Organic Farming; Climate Change

Introduction

Agricultural communication is the process of sharing information related to agriculture among farmers and people who are directly or indirectly involved with agriculture. The purpose of agricultural communication is to provide useful information to farmers that can help them achieve maximum profit (Kaur, 2022). Furthermore, farmers need information related to innovations to improve their agricultural productivity (Dharmawan et al., 2023).

Rice is still a staple food in Indonesia, making it essential for the livelihood of the people. The health and quality of rice itself need to be a concern because they can determine the quality of life for

the Indonesian people. Healthy and high-quality rice can be obtained from good production practices and without using harmful chemicals (Bakewell-Stone et al., 2008). The right way to produce healthy food is through organic farming, which does not use hazardous chemical-based agricultural materials such as synthetic fertilizers, pesticides, and so on, but relies solely on natural materials, thus it can be called farming with nature (Setiawan et al., 2016). Organic farming applied in rice field areas produces organic rice products.

In line with the goal of improving the quality of life for the Indonesian people, it is necessary to encourage innovation to provide quality and healthy food. Organic rice itself has better nutritional content such as phosphorus, iron, and phytic acid, due to the use of organic materials during the production process (Saha et al., 2007). It can be said like that because the nutritional content stored in food ingredients adjusts according to the source of fertilizer used (Li et al., 2003). Thus, the consumption of good food will affect the health and lifestyle of the community, leading to a healthier way of living.

Farmers who produce organic rice are still very few, according to data released by the Indonesia Organic Alliance in 2018, the area of rice fields implementing organic farming was only 53,975 hectares (Indonesia Organic Alliance, 2019). The amount of organic rice fields can be considered very small compared to the total agricultural land area in Indonesia, which amounts to 8,087,393 hectares (Badan Pusat Statistik, 2016). The data shows that the majority of rice varieties produced and distributed in Indonesia are not organic, suggesting that the quality of the staple food does not fully meet optimal health and environmental standard.

This is because farmers have become accustomed to inorganic farming patterns since the implementation of the Green Revolution system in Indonesia 45 years ago This situation can be attributed to the widespread adoption of inorganic farming practices, which began with the implementation of the Green Revolution in Indonesia in the mid-1960s, a period when farmers were encouraged to utilize modern agricultural technologies on a large scale, including chemical fertilizer, high-yielding crop varieties, advanced irrigation systems, and synthetic pesticides (Hansen, 1972; Indriyani et al., 2022).

At the beginning of the implementation of this system, farmers' yields were very high and successfully brought Indonesia to achieve food self-sufficiency. Not only in Indonesia, but various countries around the world also saw their rice production increase by up to 40% (Evenson & Gollin, 2003). That evidence makes farmers want to continue using that method in the hope of achieving high yields. In addition to the factor that its use is easy and quick, farmers become dependent and prefer inorganic methods without knowing the negative side effects produced. In fact, these methods can no longer increase productivity, as they have reached a saturation point (Grimm & Luck, 2023). Another threat to the agricultural industry is climate change and weather uncertainty. In the future, there will be much uncertainty in the Earth's conditions caused by climate change. The increase in temperature is the main factor in climate change and will affect the level of crop production (Burton & Lim, 2005).

Climate change can result in issues such as decreased productivity, land resource degradation, floods and droughts, and land use change (Surmaini et al., 2011).The uncertainties that may arise require agricultural practitioners to be more resilient to climate change, by engaging in food production activities in more sustainable ways. According to a World Bank study, designing agricultural systems for small farmers to be more climate-resilient is a necessity (World Bank, 2007). Organic farming can also be used as an adaptation effort to face climate change in the future (Kifle et al., 2022a).

This research aims to understand how farmers in the Wengaya Betan subak farmer group can accept innovations and changes from previously using inorganic farming methods to organic ones. The author wants to understand the pattern of innovation communication that occurs among the farmers in the Wengaya Betan subak. This research is important to conduct so that it can be applied by various parties to encourage the increase in the number of organic farmers in Indonesia. This research aims to explain the integration local cultural values and the involvement of traditional leaders in supporting the spread and re-adoption of organic farming among the Subak Wengaya Betan Farmers Group.

This study focuses on how social systems and community-based communication encourage farmers to transition back from conventional to organic practices, and provides practical insights for

developing effective, culturally-based agricultural communication strategies for climate change adaptation.

Theoretical Framework

The Diffusion of Innovations theory proposed by Everett Rogers helps us understand that communication has the goal of ensuring that one party (the communicator) and the other (the communicant) have the same knowledge from the information that has been shared. This definition of communication has become a modern and easily understandable definition in the study of communication (Hidayat, 2023). This theory emphasizes how an innovation such as organic farming can be accepted and adopted by society. Innovation communication is understood as the process of conveying information about innovations to the public, while innovation diffusion encompasses the entire process of dissemination, acceptance and adoption of innovations in a social system over time. The framework through this theory designs effective communication strategies. Through efforts to raise farmers' awareness about organic farming through communication campaigns targeting various communication channels, such as social media, community radio, and farmer group meetings. Information must be conveyed in a language that is easy to understand and relevant to the local context.

Advanced stages also encompass persuasion efforts that highlight the relative advantages of organic farming, such as long-term yield increases, reduced input costs, and contributions to climate change mitigation. Statements and testimonials from farmers who have successfully implemented organic farming can be a powerful persuasion tool. Farmers need to be supported in making decisions by providing access to resources, such as technical training, organic seeds, and markets that guarantee prices for organic products.

The Diffusion of Innovation Framework is a holistic and sustainable communication approach to encourage the adoption of organic farming as a climate change mitigation effort. This communication strategy not only focuses on behavior change but also on community empowerment and environmental justice. The Diffusion of Innovation (DoI) framework introduced by Everett Rogers does not only talk about how a technology or innovation spreads from individual to individual or from group to group. In the context of organic farming and climate change mitigation, this framework becomes a holistic communication approach because it includes Individual cognitive processes, Social and structural processes, Adoption time cycle.

Through this approach, farmers can become active agents of change in facing the challenges of climate change. The characteristics of innovation need to utilize various media as a process for extension workers to filter, select, organize, and interpret stimuli to give meaning to innovation, which is measured through relative advantage, compatibility, complexity, trialability, and observability (Rizal et al., 2021).

Material and Methodology

This research uses a qualitative research design, employing interviews, observations, and literature review as data collection techniques. In this study, we conducted interviews with several members of the Subak Wengaya Betan farmer group in Mangesta village, Tabanan Regency. Interviews were conducted with the head of the rice farmer group, group members, and organic farming initiators.

The research was conducted directly in the Mangesta Village area, Tabanan Regency. In examining the process of farmers' acceptance of organic innovation, the author uses innovation communication, which, according to Rogers, is defined as ideas, concepts, practices, experiments, and designs that are considered new, meaning they have not been implemented yet. Meanwhile, communication is the process by which a participant creates and shares information with others with the aim of achieving mutual understanding.

The first and most important step in the process of innovation adoption is understanding; to achieve understanding, the innovation is communicated repeatedly through various channels to all parties within a social system. Innovation is integrated with a new vision so that members can apply strategies in their work to achieve that vision (Hamel & Prahalad, 1994; Hülsmann & Pfeffermann, 2011; Kohles et al., 2013).

Result and Discussion

Concerns about the impact of climate change are driving food producers to urgently implement more environmentally friendly agricultural systems. If the impacts of climate change are detailed, such as drought, resource degradation, productivity decline, and land-use change. Organic farming can address some of the issues, especially drought, because water usage compared to conventional farming is relatively less due to lower evaporation rates. Therefore, this type of farming can be a solution in the event of a water crisis (Ercin et al., 2012; Wheeler et al., 2015; Wood et al., 2006).

Table 1. Comparison of the environmental impact of organic and conventional agriculture

Aspect	Organic Farming	Conventional Agriculture
Water Usage	Low	Height
Soil Nutrient Content	Increased	Decreasing
Carbon Emission	Low	Height

Source: (Wood, et al., 2006)

Organic farming greatly supports environmental sustainability, which is one of the ways to mitigate climate change. The use of organic fertilizers can make the soil more fertile in the long term, thereby positively impacting the surrounding flora and fauna (Pandey & Singh, 2012). The final fear due to climate change is the occurrence of poverty and hunger everywhere, especially in rural areas (Nyahunda & Tirivangasi, 2019). Organic farming can contribute to mitigating these impacts, especially for farmers, because production costs become lower due to relatively low and stable inputs (Badgley et al., 2007). All the solutions offered by organic farming can strengthen farmers' resilience in facing climate change.

Improving food security does not only focus on how to produce more food but also on opening access to food availability, non-agricultural development and construction such as agricultural regulations, developing agricultural product distribution networks, and related agricultural institutions such as farmer groups and farmer cooperatives (Leeuwis, 2004a).

Table 2. Climate Elements of Bali Province

Category (Unit)	Measurement Year 2023
Rainfall (mm/month)	0.8-648.6
Temperature (0C)	19.4-35.2
Air humidity (%)	43.0-100.0
Average daily solar radiation (hours/day)	2.1-10.5
Wind Speed (knot)	1-30

Source: BMKG Bali Province in Figures 2024 in BPS Bali Province

The continuously increasing human population also affects the high demand for food, along with the economic capacity of the global community to consume more food. Finally, the increase in food production is limited to the available land, because acquiring new land is very restricted. Not to mention the limited irrigated agricultural land due to the competition for water (Leeuwis, 2004b).

Regional Regulation No. 8 of 2019 on the Organic Farming System is an effort to improve public health and environmental quality. This regulation needs to be implemented widely in Bali. However, the development of organic farming in Bali is hindered by several issues such as the conversion of rice fields, which increasingly reduces the area available for farmers, the implementation of organic farming is still partial, with more focus on technical, environmental, and food safety aspects, while the economic sustainability aspect is still lacking.

Table 3. Comparison of the area of organic and conventional agricultural land in Bali

Type of Agriculture	Land Area (Hectares)	Percentage of Total Rice Fields
Organic Framing	265	0.39%
Conventional Agriculture	67.793	99.61%

Source: bali.bsip.pertanian.go.id

In comparison, a similar study in Ethiopia showed that the adoption of organic farming was strongly influenced by access to technical training, the role of extension workers, and local farmer networks, which accelerated the process of innovation diffusion in rural areas (Kifle et al., 2022b). Meanwhile, in Germany, the successful diffusion of organic farming is driven more by national policy support and strong economic incentives, as well as high consumer awareness of environmental issues (Wier & Calverley, 2002). India also shows that the influence of local leaders and community-based campaigns play a big role in encouraging small farmers to switch to organic systems (Hattam, 2022). This comparison shows that social, cultural, and policy contexts play a central role in the successful diffusion of organic farming innovations in different countries, and that local wisdom-based approaches such as those in Bali can be a typical model relevant for developing countries with strong community structures.

Diffusion of Innovation

The process of innovation diffusion by Rogers has four elements that constitute the process of delivering innovation, namely; (1) Innovation, which relates to something considered new or not yet undertaken by the information recipient, (2) communication channels, which refer to how the message is conveyed and well-received by the recipient (3) the duration from when someone receives information until they decide to accept or reject the innovation, (4) social system, this relates to social structure, system norms, the role of leaders, and change agents (Mothersbaugh & Hawkins, 2010).

Communication channels refer to the process by which people share information about an innovation and include the unit of adoption (individuals or organizations) that are already familiar with the innovation as well as other adopting units that are unfamiliar with the innovation. The element time element refers to three components, namely the innovation decision process, the adopter category adopter category and adoption rate. The innovation decision process incorporates the timeframe when an individual or organization becomes aware of an innovation until they either adopt or reject the innovation. Five steps within this process include knowledge, persuasion, decision, implementation, and confirmation (by Rogers (2003) in (Dillette & Ponting, 2021).

Innovation

Previously, like the majority of farmers in Indonesia, the farmers in the Subak Wengaya Betan farmer group had not yet practiced organic farming, making it a new innovation in agriculture. Discussing an innovation and change towards improvement must first involve understanding the advantages and benefits of taking that step. In the context of the environment, organic farming has a positive impact, especially on the soil where farmers produce food, making it more fertile as organic fertilizers are applied, and the productivity of agricultural land remains maintained (Lu et al., 2020). In line with the account of our informant Willen, a farmer in the Wengaya Betan subak, he used to apply 9 tons of organic fertilizer per hectare, but over time, its usage has decreased to 3 tons per hectare. Similarly, several other organic farmers have stated that fertilizer usage continues to decline each planting season because the soil is becoming healthier.

From an economic perspective, this type of agriculture produces organic and high-quality rice, making the product more valuable compared to non-organic products, allowing farmers to achieve better profits (Andoko, 2004). This is in line with what the head of the Wengaya Betan subak farmers' group said, that when they sell inorganic wet rice at only 3000 to 4000 rupiah per kilogram, and when they sell organic rice, the selling price reaches 6000 rupiah per kilogram. The price of organic rice can be higher because, according to the farmers of subak Wengaya Betan, in addition to being healthier and free from chemicals, the rice produced lasts longer, is fragrant, and tastes more delicious.

The reduction of agricultural inputs and dependence on chemical-based fertilizer products has increased farmers' income per harvest because agricultural capital has decreased, unlike conventional agriculture which continues to drive up fertilizer use (Sutherland & Darnhofer, 2012). The information received by the farmers of Subak Wengaya Betan is that the use of organic methods can improve the soil and prevent it from hardening like conventional methods.

Communication Channel

The traditional communication process can be described as the sender of the message, referred to as the communicator, conveying information or knowledge in the form of a message through a specific medium so that it reaches the information recipient, referred to as the receiver (McQuail, 1994). In this study, farmers in the Wangaya Betan subak group first received information and an invitation about organic farming activities from an initiator named Willen, who acted as a communicator in the process of conveying messages related to organic farming to the members of the Wengaya Betan subak farmer group, referred to here as the receiver.

According to Informant Willen, the first process of delivering innovation through a meeting forum was "... farmers are invited to gather every six months before the planting season begins, and then they are explained about organic methods..." in line with what Lis and Esa said, that they gather and learn about organic farming through meetings. In inviting the farmers to attend the meeting, an incentive was first provided in the form of monetary payment; the farmers were given cash of Rp 50,000 each time they attended the meeting. This was expressed as ".... to get the farmers to come, they are given fifty thousand rupiah...the money from the sale of organic rice and fertilizer is set aside for meeting expenses." according to him, this is a form of encouragement from the team so that farmers are willing to engage in organic farming, and in the end, the farmers responded positively to this encouragement.

Farmers, when learning something new, can be said to be less interested and bored, as expressed by informant Lis who said, "they are definitely bored learning something new..." the method used to attract farmers is by showing interesting videos about organic farming, including the stories of successful organic farmers, which makes the meetings and the dissemination of innovative knowledge not boring. In that meeting, farmers were taught methods of organic farming, even though they had not yet transitioned, it was still conveyed. The things that were taught included how to make organic fertilizer, raise cattle, use organic pesticides, and the benefits of practicing organic farming. In another note, we also found out that not only in a meeting forum, fellow farmers also encourage each other to practice organic farming. This method is carried out by farmers who have switched to organic farming to those who still use conventional methods.

Duration

An interesting finding from our research, according to all the informants in the Wengaya Betan subak group, is that it did not take long for the farmers to switch to organic farming. When it was first socialized in 2007, by 2010 it had reached 30 people, and now it has increased to 50 people, half of the total number of farmers in the Wengaya Betan subak. In digging for information on what factors caused the rapid changes, we found several things. First, most of them received stories and knowledge from their parents about organic farming. Their parents and some elderly farmers had experienced the era before the green revolution system was implemented, so they had some experience with organic farming. T

herefore, when there was an invitation to practice organic farming, the farmers were immediately confident that it could be done. Second, two years before the start of the socialization meeting and the invitation to practice organic farming, initiating farmers like Mr. Willen had conducted experiments in their rice fields with successful results. As the trials progressed, other farmers observed and talked among themselves about the successful organic farming experiment. Thus, the success of the trial results provided them with knowledge before the socialization began, and when the socialization started, the farmers easily decided to switch to organic farming.

Third, at the beginning of the socialization, the Wengaya Betan subak received free organic fertilizer subsidies and later received organic fertilizer subsidies in the form of a discount of Rp100 per kilogram. When receiving free organic fertilizer at the beginning of the first socialization, they were not hesitant to try it and were not afraid of crop failure because they had been informed beforehand that there would be times of decreased agricultural yield during the transition period.

Social System

It should be noted that the Subak group has existed since the year 1000 AD, bringing various teachings, values, norms, and agricultural systems in line with Hinduism and the region of Bali (Windia, 2018). In the subak group, the Balinese community adheres to the values of Tri Hita Karana in their way of life, one of which is maintaining a good relationship with nature or the environment.

Therefore, it is important for them to preserve nature by using organic fertilizers and agricultural materials. Thus, the head of the Wengaya Betan subak group mentioned that the organic rice they produce is called "Rice of a Thousand Prayers." Thus, in terms of the beliefs and practices of the farmers in the Wengaya Betan subak, they are very open and understanding when it comes to methods that are beneficial for the environment. The leader of Subak Wengaya Betan also participates in this organic movement, making the ecosystem of change from inorganic to organic feel very supportive. It is quite important that when conveying something, it should align with what the audience believes, just like the delivery of organic farming to the Balinese community who adhere to the Tri Hita Karana values.

In facilitating farmers who want to switch to organic farming, subak collaborates with various parties to meet the farmers' needs, such as providing a place to sell organic rice so that farmers do not have to worry about their rice not being sold. Organic fertilizers are also provided by the group because Subak Wengaya Betan has members who consistently produce organic fertilizers, so the farmers do not have difficulty obtaining organic fertilizers. Subak also established rules for farmers who have tried using organic fertilizers, prohibiting them from switching back to inorganic farming. If this is violated, a fine will be imposed, as conveyed by the chairman of Subak Wengaya Betan. Due to the hierarchical system within the subak, farmer management and the organic farming production process become easier to implement, especially for managing the upstream to downstream processes.

At the start of the socialization about organic farming, the farmers had already begun to experience difficulties in conventional farming. The difficulties that have been felt include the rising prices of agricultural basic materials such as fertilizers, pesticides, and seeds. Additionally, farmers also feel that the use of fertilizers and pesticides has been increasing over time, and many soil structures have started to harden, making it difficult to plow. Therefore, they truly need new innovations to address their conditions. So, during the first socialization, Informant Wilen talked about an area in America where the soil had been damaged due to the use of inorganic materials. The anxiety felt by the farmers increased due to the issue of soil degradation like that.

With the presence of a pioneer or initiator of organic farming in Wengaya Betan, who is described by the farmers as very enthusiastic in spreading innovations, the farmers are indirectly motivated. The Subak Wengaya Betan ecosystem, which also supports the implementation of organic farming, makes farmers think more positively about adopting organic farming. All these social factors are complemented by government support, which continues to contribute by frequently providing free organic fertilizers, conducting various training sessions, and mentoring for subak groups.

Conclusions

An effective step that can be accepted by farmers to transition to organic farming is through the development of a social system closely tied to local wisdom, combined with the active participation of traditional leaders or village officials who have and earn the trust of the community. Thus, the strategic steps related to the distribution of organic agricultural products and the innovations carried out can encourage and boost the farmers' spirit to switch to organic farming. Furthermore, the main approach is the interactive ability based on the placement of ideas to instill confidence in the transition from conventional farming to organic patterns.

Balinese agriculture is not only viewed from an economic perspective but also as a complex and harmonious intertwining of nature, culture, and social life that is continuously preserved and developed to realize sustainable Balinese agriculture. Specifically, for the Subak Wengaya Betan Farmers Group, Bali Province, the organic farming system can be one of the efforts to respond to the impacts of climate change and maintain environmental sustainability.

The novelty of this research lies in the integration of the innovation diffusion communication approach with the Tri Hita Karana local cultural values that are strongly embedded in the social structure of Subak communities in Bali. This approach shows that the successful adoption of organic farming does not only depend on technical or economic aspects, but also on the compatibility of innovation values with local belief systems and the role of traditional leaders trusted by the community. The practical implications of these findings are important for stakeholders, including local governments and extension agencies, to design more contextualized, participatory, and local culture-based agricultural communication strategies to address climate change challenges and expand sustainable agricultural practices in Indonesia.

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