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# A Study of Agricultural Biodynamic Innovation Diffusion

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**Abstract.** Online media has an advantage over other conventional media, such as television and radio, namely interactivity. This interactivity process causes two-way communication between users on social media. Although biodynamic techniques have long been discovered and developed, their application is still not developed in Indonesia. This study aims to discover how biodynamic innovation spread through the interactivity of WhatsApp media in agricultural support communities. The theory used is the McMillan interactivity model. This research also used the diffusion innovation from Rogers and Willis' three principles of biodynamic success as one of the supporting theories. In addition, this study also uses Three levels of social media analysis: the level of audience engagement, interaction, and message relationships. The results showed four significant themes for user-to-user interactivity: innovation, socialization, consultation, and information on biodynamic techniques. The use of eco enzymes and Jakaba mushrooms is the focus of interactivity in this group. The instructors' biodynamic experts and the farmers' experience in applying biodynamic techniques play a significant role in the active interactivity of the group and the spread of biodynamic innovations.

## 1. Introduction

The development of information through communication is closely related to technological developments. The invention of the internet and smartphones makes it easier for people to access the internet in their efforts to get information. The internet reached 5.3 billion, or 40 percent of the world's population. Forty-eight percent of internet users come from Asia, while people in the Americas account for 21.8 percent and Europe 19 percent of people who use internet access. China has the most significant internet users in the world, with a total of more than 721 million users [1].

Mass media is essential in connecting the world between one individual and another [2]. The mass media can reach a broad audience with a strong message and impact on society. Along with technology development, the way humans communicate also develops in terms of the media used. With the support of internet technology, people can now access information wherever and whenever they want [3].



Survey results of the Indonesian Internet Service Providers Association The 2019-2020 period, the second quarter of 2020, noted that the number of internet users in Indonesia reached 196.7 million. This number increased by 23.5 million or 8.9% compared to 2018 [4]. The number of user's internet proves that the internet has become one of the essential things in our lives. Based on the results of Hootsuite's Wearesocial research released in January 2020, internet users in Indonesia touched 175.4 million, or 64% of the total population. Compared to the previous year, the growth in the number of internet users in Indonesia experienced a significant increase from the previous year, which was 17%. This data proves that during the Covid-19 Pandemic, media consumption by the Indonesian people, including students and the public, tends to be active and continues to grow [5].

YouTube social media is the most popular platform in Indonesia, with the percentage of YouTube social media usage touching 88%, and WhatsApp occupies it with a presentation of 84%, Facebook with 82%, and Instagram with 79%. The data proves there has been an increase in the total number of social media users in Indonesia by 160 million (Junawan & Laugu, 2020). The development of technology, especially in communication and information, dramatically affects social media users in Indonesia. The internet allows people to connect and exchange information [6].

The development of internet technology is also developing in the agricultural environment. According to data from the Indonesian Association of Seed and Farmer Technology Banks (AB3TI), as quoted by the Sinartani tabloid, the number of Android-user farmers in Indonesia reached 22.35 percent, with 14.38 percent using it to search for agricultural information. The survey conducted by AB3TI covered farmers in 14 districts in 2019 to obtain data on the development of industry 4.0 in agriculture [7]. Meanwhile, research from Mulyandari found that farmers use information technology to communicate to gain knowledge about agricultural production technology and as a tool to promote agricultural products [8]. Farmers' behavior in seeking information has shifted in recent years. In the 1990s, opinion leaders carried out face to the face communication process. With the advent of radio and television, farmers began to seek information by relying on radio and TV but did not give up the direct extension process. However, in the last five years, the process of finding information has shifted through mobile applications involving public and private universities [9].

Even so, Nurhayati's research in Sidrap Regency, South Sulawesi, revealed that farmers still do not feel the benefits of using online media and do not use the internet in terms of searching for information and communication [10]. In comparison, Oktavia et al.'s research found that the radio, print media, and direct communication using the internet as a source of supporting information from the primary information sources to fellow farmers [11].

Communication and information technology are undeniable essential parts of the development of all industries, including the agricultural industry [12]. According to World Bank research, the growth of information and technology changes the capacity of farmers from large-scale to profit-oriented farmers by relying on new information technology as a supporting tool [13]. Agriculture using the cyber extension model is needed to cover weaknesses in information technology regulations in agriculture. The cyber extension is a mechanism for exchanging agricultural information through cyberspace, a virtual space that becomes a liaison between one computer network and another through communication tools. This system can develop agriculture, including production, management, marketing, and other agricultural development activities as research conducted by Rizkiansyah et al. in Lembang, Manado, and Bangil areas [13].

The cyber extension is one of the support systems for farmers to develop agricultural information innovations in terms of planting methods, timing, and behavior by decision making in the process of workers and agricultural production. The cyber extension is a support system for farmers to develop agricultural information innovations regarding farming methods, time, and appropriate behavior in labor and agricultural production decision-making [14]. The future of digital agriculture is not only caused by the media as a disseminator of technical information as one element of the spread of innovation but also must create a forum for farmers to form a network of interconnected groups between farmer groups and other groups. In addition, technology must also change towards virtual methods so Indonesian farming communities connected to the internet can meet their agricultural production needs [15].

Roger and Storey explain that diffusion of innovation theory combines diffusion and innovation words. The diffusion of innovation is a particular type of communication that deals with disseminating messages as new ideas or innovations. While the notion of communication is defined as a process in which two or more people mutually create and exchange information to gain mutual understanding. Rogers said diffusion could be defined as where the innovation process is conveyed or communicated through specific channels all the time between members of the social system [16]. The diffusion theory also explains how the innovation process is conveyed or communicated through specific channels over time to groups of members of the social system. The main idea of this theory is how new ideas are communicated to culture through channels with the time. This theory also focuses on how a specific social or cultural group adopts a new idea. The main objective of the diffusion of innovation is the adoption of an innovation, namely ideas, science, and technology, by individuals and certain social groups. Therefore, Rogers argues that four innovation characteristics can affect the level of adoption of specific individuals and social groups: relative advantage, compatibility, can be tested, and complexity. Rogers also explains four elements of diffusion innovation theory: innovation, time, channel, and society [17].

Social media is one of the most widely used types of online media by users. Good management in the use of social media for farmers can increase expectations to create marketing places that are useful for marketing agricultural products [18]. Social media can also be a liaison between farmers and consumers so that farmers can break the intermediaries' path so that product prices can be more affordable to the community and improve the welfare of farmers. Farmers can receive a suitable selling price without any price games from agricultural sales agents [8]. The Indonesian Ministry of Communication and Information results show that as many as 55.4 percent of farmers currently use mobile to access social media [19].

In recent years, researchers have begun to focus on the role of interactivity in the online world, especially online media, and social media. Research from Chen and Yen shows that the interactivity dimension does not significantly predict the quality of a website [20]. The effect of nonverbal image interactivity has more impact on customers than verbal interactivity [21]. Interactivity defines as a computer-driven experience (most often screen based) that facilitates interaction between the device and a user [22]. Meanwhile, Rafaeli understands interactivity as "the condition of communication in which simultaneous and continuous exchanges occur [23]. Montoro explained interactivity as the potential relationship of bidirectional dialogue between a system and its user [24].

Interactivity has three elements, namely 1. Dialogue that occurs between humans and computer programs. 2. The dialogue affects the nature or type of feedback or content received, changing as the dialogue continues. 3. The audience controls media content and the order (getting personalized or localized information, magnifying an image, clicking on a hyperlink) [23]. Mahmoud and Auter developed a communication interactivity model called the CMC interactivity model. According to them, there are four elements of communication interaction based on computer media: 1. user (who functions simultaneously as the sender and recipient message), 2. Medium (a condition for the existence of a channel or media supporting the interaction process between users in the CMC interactivity model), 3. A computer (represents the Medium and Messages sent to each other between the sender and receiver through a computer or online network), 4. The last is communication, which is arrangements in the form of a flexible communication environment and time according to the participant's wishes considering online communication is real-time [25]. Mc Millan divides interactivity into three parts, namely 1). user to the system where interactivity is the interaction between web technology and the user. 2). user to user. This Interactivity model communicates between the user and the host or web users 3). users to documents. Interactions occur with the activity of constructing messages on the website [26].

## 2. Materials and methods

Qualitative research is research that aims to understand the phenomena experienced by research subjects, such as behavior, perceptions, motivations, actions, and others, holistically and by describing in the form of words and language, in a unique natural context and by utilizing various natural methods [31]. This

research seeks to understand the phenomenon in social media, especially the WhatsApp community in the agricultural group, through analysis of the words in the messages in the WhatsApp group. For this reason, this study uses social media analysis on three levels [32]. At the first level, the researcher analyses success by measuring the level of engagement and audience reach. While at the second level, the research analyses the interactions that appear on WhatsApp messages to determine the innovation and interactivity that occurs based on the McMillan model. Then at the last level, analysis is carried out to see how the relationship between the message and the actors involved is based on information from the WhatsApp message track record. The object of this research is a WhatsApp group called the agricultural support community (*komunitas dukung pertanian*). This group was created on March 30, 2022 and has had 300 participants to date. The community formed an agricultural group to socialize organic farming by holding agricultural learning classes for biodynamics. Message analysis unit during July 2022 because some messages were lost on WhatsApp in March - June 2022, so it was difficult to analyse the cause of the lack of data.

### *Biodynamic agricultural*

Biodynamic is a type of agriculture based on the beliefs of Rudolf Steiner, which is like organic farming but combines esoteric concepts [27]. Organic and biodynamic management systems are characterized by low chemical use and employ various practices to create ecological stability. Standard agriculture practices are using green manure, low soil tillage, use of compost in the yard, integration with other crops, and prohibition of pesticides, synthetic fertilizers, and chemically engineered organisms [28]. Vargas et al.'s research on Brazilian farmers' perceptions of biodynamic products resulted in four themes, namely market access, product improvement, improved agricultural practices, and more excellent production organization [29]. Biodynamic agricultural research on grape vines in Germany yielded three principles for successful biodynamic techniques. First, farmers have a holistic view by placing gardens or agricultural land as part of "nature." Farmers must make the material substances, physical forces of nature, and the creative power of the cosmos to make the garden come alive. Second is the use of preparations to increase soil fertility. The setting starts from materials used for preparation, the method of preparing, to the time of implementation of preparations in the cultivation stage. Third, farmers know the critical momentum in carrying out work activities. This momentum involves various vital aspects, such as the moon's movement concerning the earth. For this reason, farmers use various lunar calendars such as Moonworxlite, Maria Thun calendar, or Stella Natura [30].

Based on the explanation in the background and literature review, this study aims to find answers to the problem of how is the interactivity and implementation of the diffusion of biodynamic innovations on Whatsapp social media in community-supported agriculture? This research aims to understand good interaction patterns to develop farmers' community groups on WhatsApp to communicate more. In addition, the results of this research can develop innovative-type content for the agricultural community.

## **3. Results and discussion**

### *3.1. The engagement of WhatsApp group*

The first level of this research is to examine the level of engagement and audience reach. At the level of engagement, the WhatsApp group supporting the agriculture community has 1310 posts, both in the form of initial posts to feedback from initial posts. From 1310 posts, spread to 182 posts in the form of images, 27 posts in the form of videos, and eight posts in the form of text information. In contrast, the rest are text responses or emoticons totaling 1093. WhatsApp agricultural support community groups have an audience reach spread across various provinces. From the results of the comments, it is known that there are several participants from outside Java, such as Banjarmasin, Kalimantan, North Sumatra, West Sumatra, and Aceh. While in Java, the participants were evenly distributed in various provinces from West Java to East Java.

**Table 1.** various posts in the agricultural biodynamic WhatsApp groups.

WhatsApp total posts	Images posts	Video posts	Text posts	Emoticons posts
1310 posts	182 posts	27 posts	8 posts	1093 posts

At the second level, the analysis focuses on the user and host interaction or between users' interactions. In general, community farmers create agricultural support community groups to socialize biodynamics to farmers so that farmers use natural methods and avoid chemicals during the gardening process. Interactivity in this WhatsApp group can be divided into several themes. 1. Innovation. Rogers explains that innovation is an idea, practice, or object considered new by individuals [16]. Innovation can be a development of a particular idea or work. In the agricultural group community, the dialogue between users only focuses on the problem of using non-chemical products in their crops.

*Mr. Yatono, if the whitening water is used to wash the squid, can it be used for the plants? Organic and easy to get?*

*Yes. Nature has provided*

The innovation lies in implementing eco enzymes or jakaba for farmers' crops. Eco enzymes result from the fermentation of organic kitchen waste such as fruit and vegetable pulp, sugar (brown sugar, brown sugar, and cane sugar), and water. Eco enzyme products are claimed to be environmentally friendly and suitable for agriculture [33]. While jakaba is a fungus that is one of the organic sources that can be used as fertilizer to fertilize plants and is generally used in the form of liquid fertilizer to be applied to plants [34].

*If the EE supply is running low, you can use 1:100. The cows from Tulungagung breeders have received a touch of Eco Enzyme on days 4-5, so they can stand up, want to eat, and look more enthusiastic and recover their health condition. Super magical ECO ENZYME. Let us be active friends for EE, so the world is more sustainable. The prizes are many miracles (for human, animal, plant health, neutralization of toxic/chemical substances).*

The innovation is not limited to eco enzymes and Jakaba but also other matters related to organic waste processing, such as the concept of establishing a café for organic farming education.

*I have a concept of building a cafe that prioritizes education about organic agriculture based on processing wet and dry organic waste into finished products that can be used immediately. Every cafe corner is planted with home medicinal plants (grass, spices, or others).*

### 3.2. Consultation.

The creation of a community group to support agriculture is not only about socializing innovation but also related to consultation. The innovations that emerged related to biodynamics *received* responses from other participants. Some participants practiced the methods that were distributed in the group. However, they experienced difficulties, so the WhatsApp group became a place to find answers to problems in the field. Some of the problems that are often consulted are using variants of natural materials for manufacturing eco enzymes.

*As for the blended mushrooms, what kind of application, sir? Pure Jakaba water can be blended and mixed.*

However, the WhatsApp group that supports agriculture does not only discuss issues related to eco enzymes or Jakaba mushrooms but also related to pests or animals that appear on farmers' crops. Farmers generally find it difficult to distinguish between animals that appear beneficial to plants or become pests that damage crops.

*I have noticed that in many chili farmer groups, it is not uncommon for farmers to spend much money to deal with lice and ticks. Sometimes farmers are discouraged because they are out of their minds and overwhelmed to deal with these two things, especially in areas where insecticides and chemical fungicides have often been applied to make pests resistant.*

*These two problems will be solved with two biological agents I posted yesterday: Nitrobacter and PSB.*

*If you look at the photo, it is not a worm but a millipede. In nature, this millipede functions to help decompose organic matter.*

*This is called a golden ladybug. If in orchid plants this pest likes to eat orchid flowers in an instant, it will be devoured.*

### 3.3. Inspiration.

Posts in groups not only socialize an innovation but also inspire farmers if an innovation proves successful. Even posting success in innovation becomes a matter of pride for farmers and inspires other farmers to implement successful innovations. However, postings with inspirational themes are often accompanied by pictures or video recordings as proof of the genuine innovations that have been made.



**Figure 1.** Pictures of plants resulting from biodynamic innovations.

These images and the like usually appear in group posts and are followed by posting comments explaining the results of the implementation of biodynamics with specific techniques. On the picture, the comments that appear are “*Cavendish bananas, only watered with EE + PSB once a week.*”

### 3.4. Information.

The agricultural support community group is a group that aims to introduce biodynamic techniques. For this reason, this group disseminates information on how to grow crops using non-chemical materials. Posts from the group also contain information on biodynamic education classes with instructors included in and outside the group. The Education class is conducted online through media zoom, but information about the event is disseminated through the group.

Community support groups for agriculture provide pure information about biodynamic farming methods, and some also provide information about chemicals. Usually, this information is disseminated because these chemicals contain misunderstandings among farmers and need to be clarified.

*The world of agriculture also requires chemicals, and one of them is calcium carbonate or  $CaCO_3$ . This chemical is used in the form of agricultural lime and has many benefits. Here are five benefits of calcium carbonate for agriculture*

*Please block your calendar for the upcoming Asia Pacific Biodynamic Conference from 21-23 Oct. Registration details to be released soon.*

At the third level of analysis, they connect the message with the actors involved. The agricultural support community group is a group with participants not only farmers but also biodynamic experts, instructors, and academics. The process of interaction occurs between biodynamic experts and *farmers* with various topics. In general, biodynamic experts become the center of the dialogue by sharing the results of the innovations they have implemented or visiting several areas and posting about biodynamic plants' success. Biodynamic experts in this group are not only from academia or government, but some are farmers who have successfully implemented biodynamic systems in their farming systems.

Apart from biodynamic experts, farmers are also one of the active elements in the discussion in this group. Generally, they post to conduct consultations on the problem of applying eco enzymes or Jabaka mushrooms. The results of discussions from farmers and biodynamic experts often produce plants with good productivity, but if the plants fail, farmers often try to find solutions by asking the group.

### 3.5. *The Interaction Model*

Willis explains that biodynamic agriculture must have three principles: 1. Farmers must have a holistic view of agriculture as part of nature 2. farmers must know biodynamic materials for the preparation process; and 3. farmers must know the lunar calendar for the success of biodynamic agriculture. The spread of innovation occurs on principle from an agriculture perspective as part of nature and the process of materials for the preparation of agricultural products. While on the momentum principle, agricultural support community groups are still very little discussed. The innovations often appear in the group are how to process natural ingredients such as Jabaka mushrooms and applying eco enzymes. They become the suitable material to support biodynamics and motivational innovations in the form of words in the form of text to make farmers aware of the importance of nature as part of plant growth compared to other chemical materials.

The group uses various supporting channels such as videos, images, and graphic texts to support the biodynamic socialization process. Image is one of the favorite supporting tools, with 182 posts. Farmers and experts use images to express the successful implementation of biodynamics or describe the difficulties in implementing it in the field. In addition, the group also posts videos to explain specific biodynamic techniques. Biodynamic experts in the group also use videos to raise farmers' awareness about the importance of using natural products by comparing the success of China.

Biodynamic experts are essential in two-way communication and innovation success in agricultural support community groups. Often experts start a discussion by throwing a success or application of specific biodynamic techniques and explaining answers to questions from farmers as feedback so that two-way communication can be established. This high interactivity can occur when experts respond to farmer responses or post more than one user. The post expert's strategy can avoid reliance on one expert in posting posts or responding to comments from other users.

At the level of user interactivity with the system, farmers have no problem with the WhatsApp application system. The WhatsApp adaptation of farmers is shown by posting as many as 1310 comments in the form of comments, videos, text, or images. Community groups use video tools to explain biodynamic techniques because it is easier for farmers to understand and apply a technique if the material comes from audiovisuals. The community uses 27 videos in this WhatsApp group to explain biodynamic techniques. In addition, the group also uses images to disseminate the results of the implementation of specific biodynamic techniques or to clarify the problems they face in agriculture.

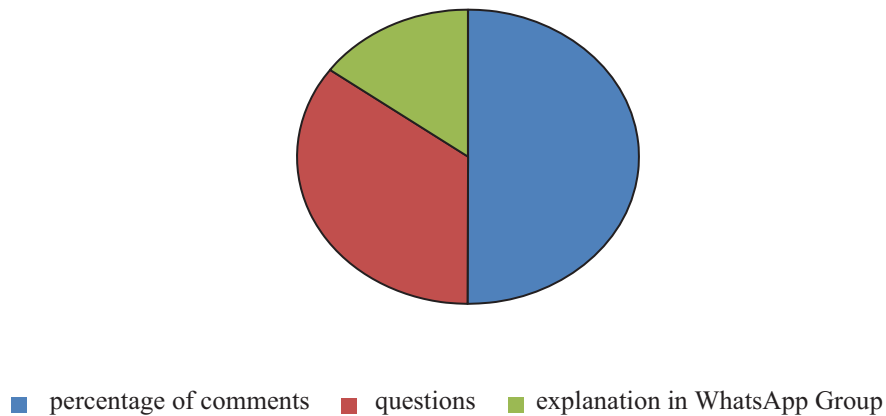
Meanwhile, in user-user interaction, the WhatsApp group is a forum that connects biodynamic experts with farmers, even though the farmers come from various regions in Indonesia. The number of experts and the activeness in posting from biodynamic experts is one of the keys to two-way communication between users. Biodynamics specialists should initiate interactions by posting biodynamic techniques or innovations from these techniques to stimulate activity from other users. Communication that occurs in the group is not only between farmers and experts but also with other farmers. The comments often arise related to interactions between farmers. The experts or other farmers answer every farmer's biodynamics problems based on their experiences. Some posted questions about other farmers who have successfully applied specific techniques of biodynamics. The interactivity that appears can be grouped into four major themes: innovations in the application of biodynamic techniques, socialization of biodynamic techniques, consultation with problems in agriculture, and information about a biodynamic event.

User-to-document interactivity is a two-way interaction that arises because the audience actively responds to content creators. Unlike conventional media such as television and radio, WhatsApp allows the audience to be active by responding to content appearing in group posts. Users in the agricultural support community's WhatsApp group actively respond to posts about biodynamic techniques. The



responses are in the form of questions, comments from their experiences, or explanations of the user's knowledge. A total of 1093 posts are responses to initial posts on various topics.

The role of experts in the WhatsApp group is not only as a supporter of the group, but also has other roles such as helping problem solving, liaison, providing information and hosting the group. As a supporter of problem solving, the experts in this WhatsApp group are the main characters where farmers look for solutions to every problem. Often experts also throw problems to other experts so that there is more than one expert in the group. Experts also often act as liaisons between government and community policies so that policies are not interpreted in various ways by farmers while also accommodating the problems that exist in the community. As information providers, experts are active in imparting innovations or knowledge related to agriculture to the group so that they become the subject of discussion by farmers while as hosts of the group, experts actively communicate with other farmers, either by means of humor, answering questions or actively asking for activities in other areas. including agricultural development.



**Figure 2.** percentage of comments, questions, and explanation in WhatsApp Group

#### 4. Conclusions

The agricultural support community uses interactivity on WhatsApp to promote biodynamic techniques. Biodynamic experts from instructors and farmers are the actors who play an essential role in the group's activities by posting regularly. Four major themes are often carried out in postings: information, consultation, innovation, and socialization.

Community groups that support agriculture develop innovations regarding biodynamic techniques based on experiments by farmers and instructors in the field. Innovators take advantage of various WhatsApp support facilities such as audiovisuals and images to support the smooth socialization of biodynamic engineering innovations. However, it will take time for farmers to respond to these innovations.

Researchers began to research interactivity in the Internet age. However, research on interactivity by linking agriculture and media is still rare. For this reason, the researcher suggests further research on the effect of interactivity on farmers and linking it to social media.

WhatsApp groups provide benefits for both knowledge and communication between agricultural stakeholders, namely farmers, experts, and the government. Through WhatsApp, government policies can be interpreted correctly by farmers. In addition, communication through WhatsApp media disseminates agricultural information and innovation. This can happen when an active expert hosts the group.

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