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*Research Article*

# The Effectiveness of Alternate Wetting and Drying (AWD) Technology Extension on Farmers' Attitudes in Implementing Paddy Water Management

## *Efektivitas Penyuluhan Teknologi Alternate Wetting and Drying (AWD) terhadap Sikap Petani dalam Penerapan Pengelolaan Air Padi Sawah*

**Selly Dion Maretti Sibarani[1]*, Nurliana Harahap[1], Ameilia Zuliyanti Siregar[2]**

[1] Department of Sustainable Agriculture, Faculty of Agriculture, Agricultural Development Polytechnic, Medan, 20002, North Sumatra, Indonesia

[2]Department of Agrotechnology, Faculty of Agriculture, University of North Sumatra, Medan, 20222, North Sumatra, Indonesia

*email: sellysibarani640@gmail.com

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***Abstract:*** Efficient water management is essential to support sustainable rice production amid increasing water scarcity and climate change. Alternate Wetting and Drying (AWD) is a water-saving irrigation technology; however, its adoption among farmers remains limited. Agricultural extension plays an important role in increasing farmers' knowledge and supporting positive attitudes toward agricultural innovations. This study aimed to analyze the effectiveness of agricultural extension on Alternate Wetting and Drying (AWD) technology in improving farmers' knowledge and attitudes toward the implementation of water management in rice cultivation in Lengau Seprang Village, Tanjung Morawa District, Deli Serdang Regency, Indonesia. The study involved 47 rice farmers selected using simple random sampling. Knowledge improvement was measured using a one-group pretest–posttest design, while farmers' attitudes were measured using a structured Likert-scale questionnaire covering cognitive, affective, and conative components. Data were collected through questionnaires, observation, interviews, and documentation and analyzed using descriptive statistics. The results showed that the average knowledge score increased from 4.13 (51.63%) in the pretest to 6.74 (84.25%) in the posttest, representing an increase of 63.20%. The analysis of farmers' attitudes showed that 76.6% of farmers demonstrated a positive attitude toward AWD implementation, consisting of 21.3% who agreed and 55.3% who strongly agreed. These findings indicate that agricultural extension on AWD technology was effective in increasing farmers' knowledge and supporting positive attitudes toward sustainable water management in rice cultivation.

*Keywords: Alternate Wetting and Drying* (AWD), agricultural extension, farmers' attitudes, farmers' knowledge, rice water management.

***Abstrak:*** Pengelolaan air yang efisien sangat penting untuk mendukung produksi padi berkelanjutan di tengah meningkatnya kelangkaan air dan perubahan iklim. Alternate Wetting and Drying (AWD) merupakan teknologi irigasi hemat air; namun, penerapannya di kalangan petani masih terbatas. Penyuluhan pertanian berperan penting dalam meningkatkan pengetahuan petani dan mendukung sikap positif terhadap inovasi pertanian. Penelitian ini bertujuan untuk menganalisis efektivitas penyuluhan pertanian mengenai teknologi AWD dalam meningkatkan pengetahuan dan sikap petani terhadap penerapan pengelolaan air pada budidaya padi di Desa Lengau Seprang, Kecamatan Tanjung Morawa, Kabupaten Deli Serdang, Indonesia. Penelitian ini melibatkan 47 petani padi yang dipilih menggunakan teknik simple random sampling. Peningkatan pengetahuan diukur menggunakan desain one-group pretest-posttest, sedangkan sikap petani diukur menggunakan kuesioner berskala Likert terstruktur yang mencakup komponen kognitif, afektif, dan konatif. Data dikumpulkan melalui kuesioner, observasi, wawancara, dan dokumentasi, serta dianalisis menggunakan statistik deskriptif. Hasil penelitian menunjukkan bahwa rata-rata skor pengetahuan meningkat dari 4,13 (51,63%) pada *pretest*

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menjadi 6,74 (84,25%) pada *posttest*, yang mencerminkan peningkatan sebesar 63,20%. Analisis sikap petani menunjukkan bahwa 76,6% petani menunjukkan sikap positif terhadap penerapan AWD, yang terdiri dari 21,3% yang menyatakan setuju dan 55,3% yang menyatakan sangat setuju. Temuan ini mengindikasikan bahwa penyuluhan pertanian mengenai teknologi AWD efektif dalam meningkatkan pengetahuan petani dan mendukung sikap positif terhadap pengelolaan air berkelanjutan dalam budidaya padi.

*Kata kunci: Alternate Wetting and Drying* (AWD), penyuluhan pertanian, pengetahuan petani, pengelolaan air padi, sikap petani,

## INTRODUCTION

Rice (*Oryza sativa* L.) is a major staple crop and an essential component of food security in Indonesia. However, the sustainability of rice production is increasingly challenged by rising irrigation demand, climate variability, water scarcity, and growing competition for freshwater resources. Rice cultivation requires substantial water inputs, with total water requirements commonly ranging from approximately 1,200 to 1,500 mm per growing season, depending on climatic conditions, soil characteristics, and irrigation management (Suwanmaneepong et al., 2023). These challenges have increased the need for climate-smart rice production systems that can improve water-use efficiency while maintaining stable crop productivity. Accordingly, improving water management is not only an agronomic concern but also an important component of climate-resilient and resource-efficient food production.

Alternate Wetting and Drying (AWD) has emerged as a climate-smart water management technology that alternates between flooded and non-flooded conditions according to crop water requirements (Taufik et al., 2024). Previous studies have reported that AWD can reduce irrigation water use while maintaining rice productivity and improving water-use efficiency (Bwire et al., 2024; Dou et al., 2025; Johnson et al., 2024). In addition, AWD can influence soil aeration, root-zone conditions, nutrient dynamics, and greenhouse gas emissions. However, these effects are not uniform across production systems and may vary depending on soil properties, irrigation thresholds, crop growth stage, water-control infrastructure, and the quality of field-level management (Enriquez et al., 2021; Widyastuti et al., 2025; Dahlgreen & Parr, 2024). Therefore, the benefits of AWD should not be considered solely as an inherent consequence of the technology, but rather as outcomes that depend on appropriate implementation and site-specific management. This highlights the importance of understanding not only the technical performance of AWD but also the factors that determine whether farmers are willing and able to implement the technology correctly.

The adoption of AWD is influenced by more than its technical benefits. Farmers' decisions to adopt water-saving technologies may be affected by their knowledge, perceptions of benefits and risks, irrigation conditions, socioeconomic characteristics, and established cultivation practices (Samoy-pascual et al., 2022). Based on the Identification of Regional Potential and preliminary interviews with agricultural extension workers and rice farmers in Tanjung Morawa District, many farmers continue to practice continuous flooding because of established cultivation habits and the perception that maintaining standing water is a safer method for rice production. These conditions suggest that the implementation of AWD requires changes not only

in farming practices but also in farmers' understanding and perceptions of water management. Attitude is a multidimensional construct consisting of cognitive, affective, and conative components, representing what individuals understand, how they evaluate or feel about an innovation, and their tendency to act toward it (Fajri et al., 2022). In the context of AWD, these components are closely related to adoption readiness: farmers must first understand the principles and procedures of AWD, develop favorable perceptions of its feasibility and benefits, and demonstrate a behavioral tendency to apply the recommended water management practices. Agricultural extension can contribute to this process by providing information, facilitating learning, and supporting farmers in evaluating and applying agricultural innovations (Damayanti et al., 2025).

Although previous studies on AWD have predominantly examined technical performance, water-saving potential, agronomic outcomes, and environmental benefits (Bwire et al., 2024; Dou et al., 2025; Taufik et al., 2024; Johnson et al., 2024; Dahlgreen & Parr, 2024), less attention has been given to the relationship between agricultural extension, farmers' knowledge, and attitudinal readiness toward AWD implementation at the local level. This distinction is important because technical feasibility does not necessarily translate into farmer adoption, while positive attitudes alone do not guarantee technically correct implementation. Therefore, examining knowledge improvement following an extension activity together with farmers' cognitive, affective, and conative attitudes toward AWD can provide a more comprehensive assessment of farmers' readiness to implement water-efficient rice cultivation. Accordingly, this study aimed to assess changes in farmers' knowledge following agricultural extension on AWD and to characterize farmers' attitudes toward the implementation of AWD in rice cultivation in Lengau Seprang Village, Tanjung Morawa District, Deli Serdang Regency, Indonesia. Knowledge change was assessed using a one-group pretest–posttest design, while farmers' attitudes were evaluated using a structured questionnaire based on cognitive, affective, and conative components. Rather than assuming a causal effect on attitudes, the study assessed the level and characteristics of farmers' attitudes toward AWD following the extension activity.

## MATERIALS AND METHODS

This study was conducted from March to April 2026 in Lengau Seprang Village, Tanjung Morawa District, Deli Serdang Regency, North Sumatra Province, Indonesia. The study area was purposively selected based on the results of the Identification of Regional Potential (Identifikasi Potensi Wilayah/IPW) and preliminary interviews with agricultural extension workers and rice farmers. The IPW and preliminary assessment indicated that rice farmers in the study area predominantly practiced continuous flooding and had not widely implemented Alternate Wetting and Drying (AWD) technology for rice water management. The IPW was conducted as part of the preliminary assessment of the study area to identify farmers' existing water management practices and the level of AWD technology implementation. This study employed a quantitative descriptive approach. A one-group pretest–posttest design was used to assess changes in farmers' knowledge before and after the agricultural extension activities, while

farmers' attitudes toward AWD technology were assessed after the extension activities using a structured Likert-scale questionnaire. Therefore, knowledge improvement was analyzed based on the difference between pretest and posttest scores, whereas farmers' attitudes were described based on their level of agreement with the application of AWD technology.

The study population consisted of 89 rice farmers who were members of farmer groups in Lengau Seprang Village. A sample of 47 farmers was selected using simple random sampling, in which each eligible farmer had an equal opportunity to be selected as a respondent. The inclusion criteria were farmers who actively cultivated rice in Lengau Seprang Village, were members of a farmer group in the study area, participated in the agricultural extension activities on AWD technology, and were willing to participate in the study and complete the research questionnaire. Farmers who did not participate in the extension activities or did not complete the questionnaire were excluded from the analysis. The agricultural extension intervention focused on the application of AWD technology for water management in rice cultivation. The extension materials covered the concept and principles of AWD, the benefits of efficient water management, the appropriate timing of AWD application, the use of an AWD observation tube, and procedures for monitoring and managing water levels in rice fields. The extension activities were delivered through video presentations, demonstrations, group discussions, individual farmer visits, and farm visits. Demonstrations were used to explain the use of the AWD observation tube and the practical procedures for monitoring water levels in rice fields. The extension activities were conducted in the rice-farming area of Lengau Seprang Village and were facilitated by the researcher. All respondents received the same extension materials and participated in the same extension program.

Primary data were collected through structured questionnaires, direct observation, interviews, and documentation, while secondary data were obtained from the Agricultural Extension Center and other relevant institutional records. The research instrument was developed based on the objectives of the study and indicators of farmers' knowledge and attitudes toward AWD technology. The attitude questionnaire consisted of statements representing three components: cognitive, affective, and conative. The cognitive component reflected farmers' understanding and beliefs regarding AWD technology, the affective component reflected farmers' feelings and evaluations of AWD, and the conative component reflected farmers' willingness or behavioral tendency to apply AWD technology. The attitude statements were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating a more positive attitude toward the application of AWD technology. Farmers' knowledge was measured using objective questions administered before and after the extension activities. The pretest and posttest measured the same knowledge indicators to assess changes in farmers' knowledge following the extension intervention. Before being used for data collection, the research instrument was tested for validity and reliability. Item validity was assessed using the Pearson Product-Moment correlation, with an item considered valid when the calculated correlation coefficient was greater than the critical correlation value and the significance value was less than 0.05. The reliability of the instrument was assessed using Cronbach's alpha coefficient to determine its internal consistency.

The knowledge questionnaire was administered before and after the extension activities to obtain pretest and posttest scores, while the attitude questionnaire was administered after the extension activities to assess farmers' level of agreement with the application of AWD technology. Observation and interviews were used to obtain supporting information regarding farmers' rice cultivation practices, water management practices, and responses to AWD technology. Data were analyzed using descriptive quantitative analysis. Knowledge scores were summarized using the mean pretest and posttest scores, and the percentage increase in knowledge was calculated by comparing the difference between the mean posttest and pretest scores with the mean pretest score. Farmers' attitudes were analyzed using the total Likert-scale score and converted into percentages by comparing the observed score with the maximum possible score and multiplying the result by 100%. The percentage distribution of respondents across attitude categories was also calculated. The attitude results were interpreted descriptively based on the level of agreement with the application of AWD technology. Statistical analysis was performed using Microsoft Excel and IBM SPSS Statistics. Because the study did not include a control group or pre-intervention measurement of farmers' attitudes, the attitude analysis was interpreted descriptively and was not used to establish a causal effect of the extension intervention on changes in attitudes. The effectiveness of the extension intervention was primarily assessed based on the observed improvement in farmers' knowledge, while farmers' attitudes were characterized based on their level of agreement with AWD technology after the extension activities.

Participation in the study was voluntary. Before data collection, respondents were informed about the purpose and procedures of the study, and informed consent was obtained from each participant. Respondents were informed that they could decline to participate or withdraw from the study without penalty. The confidentiality of respondents' personal information and research data was maintained throughout the study. The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to the protection of respondent confidentiality and applicable institutional requirements.

## RESULTS AND DISCUSSION

### Knowledge Improvement Following Agricultural Extension

The change in farmers' knowledge regarding the application of Alternate Wetting and Drying (AWD) technology was assessed using a one-group pretest–posttest design. The results are presented in Table 1. The results indicate that the farmers' average pre-test score was 4.13 (51.63%), while the average post-test score rose to 6.74 (84.25%). With a maximum possible score of 8.00, this represents an average increase of 2.61 points. These findings demonstrate an improvement in farmers' knowledge, with a percentage increase of 63.20%, placing the result in the "good" category. The results show that the extension activities successfully enhanced farmers' understanding of the Alternate Wetting and Drying (AWD) method in paddy rice cultivation. This knowledge gain indicates that the extension material was effectively received and understood by the target audience. This success was facilitated by the use of appropriate

extension methods such as discussions and demonstrations enabling farmers to directly grasp the concepts and practical application of AWD in their rice fields.

Table 1. Comparison of Farmers' Knowledge Scores Before and After the AWD Extension Activity

| value type | Calculation | Results | Persentase (%) |
|---|---|---|---|
| Average pre-test score | 194/47 | 4,13 | 51,63% |
| Average post-test score | 317/47 | 6,74 | 84,25% |
| Maximum average value | 376/47 | 8,00 | |
| Mean difference value | 6,74 – 4,13 | 2,61 | |
| (%) Increase in Knowledge | 2,61/4,13*100% | 63,20% | |

Furthermore, the use of practical demonstration methods during extension activities proved effective in improving farmers' understanding by allowing them to witness the innovation's application firsthand in the field. This aligns with the findings of Hidayat et al., (2024), who stated that the adoption and implementation of technology in rice farming are heavily influenced by extension processes that effectively enhance understanding and foster behavioral changes among farmers regarding agricultural innovations.

## Farmers' Attitudes toward AWD Technology

The distribution of farmers' attitudes toward the application of Alternate Wetting and Drying (AWD) technology is presented in Table 1. Among the 47 respondents, 26 farmers (55.3%) strongly agreed with the application of AWD technology, while 10 farmers (21.3%) agreed. A total of 7 farmers (14.9%) were categorized as somewhat agreeing, and 4 farmers (8.5%) disagreed. No respondents were categorized as strongly disagreeing. Overall, 36 of the 47 respondents (76.6%) expressed agreement or strong agreement with the application of AWD technology.

Table 1. Distribution of Farmers' Attitudes toward the Application of AWD Technology

| Criteria | Mark | Number of people | Percentage (%) |
|---|---|---|---|
| Strongly Disagree | 12–21 | 0 | 0 |
| Don't agree | 22–31 | 4 | 8,5 |
| Simply Agree | 32–41 | 7 | 14,9 |
| Agree | 42–51 | 10 | 21,3 |
| Strongly agree | 52–61 | 26 | 55,3 |
| **Jamount** | | **47** | **100** |
| **Farmer Attitude Level** | | **76,6** | **Good** |

The score ranges in Table 1 were determined based on the total score obtained from the attitude questionnaire and the predetermined five-category classification. The

categories ranged from strongly disagree to strongly agree, with higher scores indicating a more favorable attitude toward the application of AWD technology.

The predominance of respondents in the agree and strongly agree categories indicates that farmers generally showed a favorable attitude toward AWD technology after participating in the extension activities. However, this result should be interpreted as a description of farmers' attitudes following the extension activity rather than as evidence that the extension intervention caused an improvement in attitudes. The finding indicates that most respondents expressed acceptance of AWD as a potential alternative for managing water in rice cultivation.

The positive distribution of responses can be interpreted through the three components of attitude: cognitive, affective, and conative. The cognitive component relates to farmers' understanding and beliefs about AWD technology, including its principles and potential benefits. The affective component reflects farmers' evaluations and feelings toward the technology, including their perceptions of the benefits and feasibility of AWD. The conative component reflects farmers' willingness or behavioral tendency to consider applying AWD in their farming activities. The relatively high proportion of respondents who agreed or strongly agreed suggests that the extension activity was accompanied by a generally favorable level of acceptance toward AWD technology. Nevertheless, because the three attitude components were not measured using a pre-intervention and post-intervention comparison, the results cannot establish that the extension activity caused a change in farmers' attitudes.

The finding is consistent with Fajri et al. (2022), who explained that attitude is an important factor associated with an individual's tendency to accept or reject an innovation. In the context of the present study, farmers' favorable attitudes toward AWD indicate a level of attitudinal readiness to consider the technology as an alternative water management practice. This finding is important because the adoption of agricultural innovations depends not only on technical performance but also on farmers' perceptions, evaluations, and willingness to consider applying the innovation.

Previous studies have primarily examined the technical and environmental dimensions of AWD, including water-use efficiency, rice productivity, and the sustainability of water management (Bwire et al., 2024; Enriquez et al., 2021; Taufik et al., 2024). The present study complements this body of research by highlighting the extension and social dimension of AWD implementation. The results show that, following participation in the extension activities, most farmers expressed agreement or strong agreement with AWD technology. This finding suggests that agricultural extension may provide an important platform for communicating the principles and potential benefits

of AWD and for assessing farmers' readiness to consider water-saving technologies. However, the favorable attitudes observed in this study should not be interpreted as evidence of actual adoption. Further assessment of farmers' subsequent practices is required to determine whether positive attitudes are translated into the implementation of AWD in rice fields.

## Relationship between Knowledge and Attitudes toward AWD Implementation

The study produced two distinct outcomes related to the AWD extension activity. First, farmers' mean knowledge score increased from 4.13 in the pretest to 6.74 in the posttest, representing a calculated increase of 63.20%. Second, the post-extension attitude assessment showed that 76.6% of respondents expressed agreement or strong agreement with the application of AWD technology.

These outcomes should be interpreted separately because knowledge was measured before and after the extension activity, whereas attitudes were measured only after the extension activity. Therefore, the results demonstrate a higher measured knowledge score following the extension activity and a generally favorable attitude toward AWD at the time of the post-extension assessment. Although the present study does not demonstrate that the increase in knowledge directly caused favorable attitudes, the findings indicate that farmers who had participated in the extension program possessed a better understanding of AWD while simultaneously expressing positive perceptions toward its implementation.

The findings are consistent with previous studies emphasizing that farmers' knowledge is a fundamental prerequisite for evaluating agricultural innovations before adoption decisions are made. Horner et al., (2022) reported that farmers require adequate technical knowledge to understand and evaluate complex agricultural technologies, thereby reducing uncertainty during the decision-making process. (Suprehatin, 2021) explained that knowledge obtained through agricultural extension enables farmers to recognize the relative advantages of new technologies and supports informed decision-making regarding technology adoption. These studies suggest that strengthening farmers' knowledge through extension activities provides an important foundation for developing positive perceptions toward agricultural innovations, including AWD technology.

The generally favorable attitudes observed in this study are also supported by previous research indicating that farmers tend to respond positively to agricultural technologies when they clearly understand their potential agronomic, economic, and environmental benefits. A recent meta-analysis by Ruzzante et al., (2021) identified access to agricultural information and extension services as among the most influential factors

affecting farmers' decisions to adopt agricultural technologies in developing countries. Likewise, Hidayat et al. (2024) demonstrated that effective agricultural extension not only improves farmers' technical understanding but also encourages positive behavioural changes that facilitate the acceptance of agricultural innovations. In the context of AWD, increased knowledge regarding irrigation scheduling, water-level monitoring, and efficient water management may therefore contribute to farmers' positive attitudes toward the technology.

Nevertheless, knowledge and favorable attitudes alone cannot ensure technology adoption. The decision to implement AWD under field conditions is influenced by various interacting factors, including irrigation infrastructure, water availability, extension follow-up, institutional support, production costs, labour availability, and farmers' perceptions of production risks. Hassan et al., (2024). similarly concluded that adoption of agricultural technologies depends not only on farmers' knowledge but also on socioeconomic, institutional, and environmental conditions that determine whether a technology can be practically implemented. Consequently, although the present study indicates encouraging levels of knowledge and positive attitudes toward AWD, further longitudinal studies are needed to examine whether these outcomes translate into sustained AWD adoption and improved irrigation performance in farmers' fields.

## Limitations of the Study

This study has several limitations. First, the research involved 47 farmers from a single village, which limits the generalizability of the findings to rice farmers in other regions with different agroecological, irrigation, and socioeconomic conditions. Second, farmers' attitudes were measured only after the extension activity; therefore, changes in attitudes before and after the intervention could not be assessed. Third, the study did not include a control group, limiting the ability to establish a causal relationship between the extension activity and the observed outcomes. Fourth, the attitude data were obtained using self-reported questionnaires and may therefore be influenced by social desirability bias or respondents' perceptions of expected responses. Fifth, the study assessed attitudes toward AWD but did not directly measure actual technology adoption, irrigation water savings, rice yield, or other field-level outcomes. Therefore, a favorable attitude should not be interpreted as confirmed AWD adoption.

Future research should involve larger samples and multiple research locations and should include pre- and post-intervention measurements of attitudes and, where possible, a control or comparison group. Further studies should also examine whether improvements in farmers' knowledge and favorable attitudes are translated into actual

AWD adoption and measurable improvements in irrigation water-use efficiency and rice production outcomes.

## CONCLUSIONS

The agricultural extension activity on Alternate Wetting and Drying (AWD) technology was associated with an improvement in farmers' knowledge regarding rice water management. The mean knowledge score increased from 4.13 (51.63%) in the pretest to 6.74 (84.25%) in the posttest, representing a calculated increase of 63.20%. In addition, the post-extension attitude assessment showed that 36 of 47 respondents (76.6%) agreed or strongly agreed with the application of AWD technology. These findings indicate that the respondents demonstrated improved knowledge following the extension activity and generally favorable attitudes toward AWD technology at the time of the post-extension assessment.

However, because the study did not include a control group or pre-intervention measurement of attitudes, the results do not establish a causal effect of the extension activity on changes in farmers' attitudes. The favorable attitudes observed in this study indicate potential attitudinal readiness to consider AWD technology, but they do not necessarily represent actual adoption. The findings therefore suggest that agricultural extension has potential to support the dissemination and acceptance of water-efficient rice management technologies, although actual AWD adoption, irrigation water savings, rice productivity, and long-term sustainability outcomes were not directly measured in this study.

The generalizability of the findings is limited by the sample size of 47 farmers and the single study location in Lengau Seprang Village, Tanjung Morawa District. Future research should involve larger samples and multiple study locations, use pretest–posttest measurements of both knowledge and attitudes, and include a control or comparison group where possible. Further studies should also directly measure actual AWD adoption, irrigation water use, rice productivity, and the relationship between farmers' knowledge, attitudes, and subsequent adoption behavior.

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