

Mechanized Rice Cultivation Through Smart Farming Using Artificial Intelligence Basis of Rice Farmers in Bongabong, Oriental Mindoro

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ABSTRACT

Mechanized rice cultivation through smart farming using artificial intelligence (AI) has gained considerable interest as a means to improve agricultural practices and increase productivity. This study focuses on the application of smart farming technology in Bongabong, Oriental Mindoro, Philippines, with the aim of optimizing rice production. Data were collected through self-administered questionnaires, and statistical analyses using descriptive and inferential statistics were conducted. The findings indicate a gender imbalance among farmers utilizing smart farming technologies, with a higher representation of males. The study identified challenges in terms of limited trained operators, inadequate infrastructure and support facilities, high operational costs, and market limitations. The study also highlighted the environmental implications of smart farming technology, such as improved water management, reduced chemical inputs, and enhanced soil health. Overall, the study underscores the importance of education, training, and collaborative efforts to promote the adoption of smart farming technology in rice cultivation. By leveraging AI and innovative farming techniques, rice farmers in Bongabong, Oriental Mindoro can enhance productivity, sustainability, and economic outcomes.

INTRODUCTION

Rice farming has been a prominent industry in Bongabong, Oriental Mindoro, Philippines, providing a livelihood for millions of farmers and food for the country's rapidly growing population. However, with continuously increasing competition in the market, more than traditional farming methods may be needed to satisfy the demands of the modern world. There has been a remarkable increase in the interest surrounding the application of intelligent farming technology in recent years, aiming to enhance agricultural practices and increase productivity. Oriental Mindoro, despite being known as one of the country's emerging ecotourism destinations, is also recognized for its vast rice fields and is one of the major rice-producing provinces in the region. This research project focuses on optimizing pioneering mechanized rice farming through innovative farming techniques to enhance rice production in the area. The project aims to assess the efficacy of different innovative farming technologies in improving rice production. The study will include a comprehensive review of the rice fields in Oriental Mindoro and an analysis of soil conditions, weather patterns, and water management practices. Field experiments will also be conducted as part of the project to assess the impact of intelligent farming technologies on rice production, yield, and quality. The study's findings will provide insight into how smart farming technology can optimize rice farming practices in the Philippines and other developing countries, particularly Oriental Mindoro. Overall, this research project aims to contribute to the continuous production of the agriculture sector in Oriental Mindoro and the Philippines by encouraging rice farmers to adopt innovative farming technology. The study's findings will also provide the basis for policy recommendations to support the country's widespread adoption of innovative farming technology. Rice farming is a vital economic activity in Bongabong, Oriental Mindoro Philippines, with vast land dedicated to the crop. However, rice farming faces many challenges, including rising production costs, low productivity, and environmental degradation. As a result of these challenges, smart farming technology has emerged as a potential solution for optimizing rice farming practices. Oriental Mindoro, a province in the southern Tagalog region of the Philippines, has already pioneered mechanized rice farming. However, due to limited access to modern technology and practices, the full potential of this strategy has yet to be noticed. It may be possible to address the challenges and realize the full potential of mechanized rice farming in Oriental Mindoro by implementing smart farming technology. As a result, the researcher conducted this study with the goal of providing specific answers to the demographic profile of rice farmers regarding gender, participation, and educational background. Current challenges facing mechanized rice farming in Bongabong, Oriental Mindoro are essential to educate and train rice farmers on optimizing the use of smart farming technology. Pioneering mechanized rice farming in Bongabong, Oriental Mindoro. The focus of this study is to examine how farmers in Bongabong, Oriental Mindoro, adapt and apply smart farming technology in their mechanized rice cultivation activities. To understand this, researchers utilize a theory known as the Diffusion of Innovations (DOI) theory

by E. Rogers, 1962, which explains how new technologies get adopted. The theory focuses on five essential characteristics of a new technology that influence its adoption. The first characteristic is a relative advantage, which pertains to the benefits that farmers see from utilizing smart farming technologies. These benefits include better production of crops, lower labor expenses, and increased profitability. Farmers are more interested to use technology because they perceive these benefits. The second characteristic is compatibility, which refers to how well the smart farming technology integrates with the farmers' existing methods, values, and needs. Farmers are more likely to adopt new technology if it suits what they already possess. Complexity refers to the degree farmers perceive smart farming technology as difficult to understand and use. Trialability refers to the degree to which farmers can experiment with and test the technology before fully adopting it. Observability refers to the degree to which the outcomes of using smart farming technology are visible and measurable. The third characteristic is complexity, which refers to how difficult farmers believe smart farming technologies to be. Farmers may be unwilling to adopt new technology if it is perceived to be too complicated or challenging to understand and apply. The fourth characteristic is trialability, which means that farmers can try and experiment with the technology before fully committing to it. They are more inclined to adopt it if they can try it out and see its benefits. The last feature is observability, which refers to how obvious and measurable the results of adopting smart farming technologies are. Farmers are more willing to adopt new technology if they see the benefits, such as greater agricultural yield or profitability. The study also considers socio-demographic aspects such as age, education level, and farming experience, which can influence farmers' attitudes and adoption of smart farming technologies. This theoretical framework helps us understand the factors that affect how rice farmers in Oriental Mindoro adopt and use smart farming technology. It helps us see how farmers view the technology and how it relates to the Diffusion of Innovations theory, which explains how new ideas or technologies spread among people.

METHODOLOGY

This chapter gives an overview of the research methods used in the study. It provides details about the participants, including who they were and how they were chosen. The researcher explains the research design used and why it was selected. The data collection instrument is also described, along with the steps taken to conduct the study. The researcher employed a quantitative research approach with a cross-sectional survey design in this study to explore the implementation of smart farming technology in automated rice farming in Bongabong, Oriental Mindoro. The study will select a sample of rice farmers who utilize or have the potential to use smart farming technologies using a combination of random and purposive sampling methods. Self-administered questionnaires will be provided electronically or in person to collect data. A series of questions will be included in the questionnaire. The questionnaire results will be evaluated using descriptive and inferential statistics to measure and assess the connection between smart farming technology utilization and rice

farming outcomes. In general, the cross-sectional survey design and quantitative technique will give a systematic and comprehensive approach to figuring out how smart farming technology is used in mechanized rice farming in Oriental Mindoro. Overall, the locale of Bongabong, Oriental Mindoro, provides an ideal setting for investigating the use of smart farming technology in mechanized rice farming, given its concentration on rice farmers and unique environmental and socio-economic conditions. The sample of interest in this study includes rice farmers in Bongabong, Oriental Mindoro, who utilize or may adopt smart farming technology in mechanized rice farming. The study will select a representative sample from this population using a variety of random sampling approaches. Participants are randomly chosen from a list of registered rice farmers in Oriental Mindoro using a unique identifier and a random number generator. Purposive sampling involves selecting participants based on specific characteristics, such as those who have recently adopted smart farming technologies or have expressed an interest in doing so, as well as farm size, years of experience, and level of education. The objective of this research is to find a diverse and representative sample of rice farmers in Bongabong, Oriental Mindoro, who use or can use smart farming technology in mechanized rice farming. The major data collection instrument for this study will be a self-administered questionnaire. A number of questions will be contained within the questionnaire in order to collect quantitative data from rice farmers in Bongabong, Oriental Mindoro. The questionnaire will focus on their use of, or interest in, smart farming technology for automated rice cultivation. The questionnaire will be distributed either electronically or in person, depending on the preferences of the participants. The questionnaire's goal is to collect quantitative data on the use of smart farming technologies in automated rice farming operations in Bongabong, Oriental Mindoro.

Statistical Treatment of Data

The researcher will employ the statistical approach mentioned below to comprehend the data properly. The percentage and weighted mean are used to examine data.

1. Percentage

These will determine respondents' frequency counts and percentage distribution of personal-related variables.

Formula:
$$\% = \frac{F}{N} \times 100$$

% = percentage

F = frequency

N = total number of respondents

100 = constant value

2. Average Weighted Mean

These will be used to assess the respondents' responses to each statement.

Formula:
$$X = \frac{Fx}{N}$$

X = weighted mean

F = frequency

x = weight of each item

N = number of respondents

Table 1. Interpretation of Weighted Mean

WEIGHTED MEAN	DESCRIPTION
4.20-5	Strongly agree
3.40-4.19	Agree
2.60-3.39	Neutral
1.80-2.59	Disagree
1-1.79	Strongly disagree

RESULTS AND DISCUSSION

This chapter provides a summary of the findings, conclusions, and recommendations that were derived from analyzing the research data presented in the previous chapter. The study's findings provided an understanding of the gender distribution, involvement levels, educational backgrounds, obstacles, and possible benefits of using smart farming technology in automated rice cultivation in Bongabong, Oriental Mindoro.

Gender Distribution

The study noticed a gender imbalance among rice farmers that use smart farming technologies, with 68% male and 32% female. This indicates that women are less likely to be involved in automated rice production utilizing Artificial Intelligence.

Levels of Participation

Most rice farmers in Bongabong actively participate in mechanized rice growing using smart farming technologies. Approximately 92% acknowledged considerable participation and effective use of this technology. There is still space for development since 6% indicated moderate utilization and 2% claimed minimum or no engagement.

Educational Backgrounds

A significant percentage of rice farmers in Bongabong, Oriental Mindoro, 42% have completed secondary school. In addition, 30% of farmers have a college or university degree, and 24% have vocational or technical training. These figures emphasize rice farmers' broad educational backgrounds, with a strong emphasis on higher education and specialized training, contributing to their capacity to effectively use smart farming techniques.

Challenges

The study identified numerous obstacles to mechanized rice growing in Bongabong. These include a shortage of trained operators and technicians, a lack of infrastructure and support facilities, high operational expenses, the influence of market boundaries on profitability, and a need for proper roads and storage facilities. Addressing control of these issues is essential for increasing the efficiency and profitability of mechanical rice cultivation.

Education and Training

The study found a need to educate and train rice farmers on smart farming technologies. Recognizing the potential benefits, enhancing decision-making and operational efficiency, and raising awareness about the consequences of a lack of knowledge are all critical. Investing in farmer education and incorporating ICT into farming can result in long-term benefits for the rice farming business.

CONCLUSIONS

The demographic profile of rice farmers in Bongabong, Oriental Mindoro, indicates a gender imbalance, with fewer women participating in smart farming technology. A large percentage of rice farmers actively participate in and use these technologies. Farmers have a diverse educational backgrounds, with a strong emphasis on higher education and specialized training, which helps them employ smart farming techniques efficiently. A shortage of skilled operators and technicians, insufficient infrastructure and support facilities, high operational costs, the impact of market constraints on profitability, and a lack of proper roads and storage facilities are among the current challenges confronting mechanized rice farming in Bongabong, Oriental Mindoro. Addressing these issues is critical for improving the efficiency, profitability, and long-term viability of automated rice agriculture in the region. Educating and training rice farmers on smart farming technology optimization is critical for developing mechanized rice cultivation in Bongabong, Oriental Mindoro. It enables farmers to better understand the possible benefits, make better decisions, raise awareness about the consequences, and secure long-term benefits for their farming enterprises. The region may unlock the full potential of smart farming technologies and drive sustainable agricultural development by investing in farmer education and incorporating ICT into farming operations.

RECOMMENDATIONS

To encourage more rice farmers in Bongabong, Oriental Mindoro, to adopt smart farming technology in mechanized rice cultivation, these are the following recommendations. Assist rice farmers with financial help or incentives to purchase smart farming equipment. These may help to lower costs and make technology more inexpensive and accessible. Conduct training sessions and workshops centered on smart agricultural technology. These programs should improve farmers' understanding of the technology, its benefits, and how to apply it effectively in rice farming. Organize awareness campaigns and knowledge-sharing initiatives to educate farmers about smart agricultural technology's benefits and practical applications. To present the facts, use simple and accessible language and demonstrate real-life examples of achievement.

REFERENCES

- Iida, S. (2023). Precision Agriculture in Rice Farming. Springer EBooks, 239–250. https://doi.org/10.1007/978-3-031-15258-0_13
- Iba, H., & Lilavanichakul, A. (2023, March 1). Farm Business Model on Smart Farming Technology for Sustainable Farmland in Hilly and Mountainous Areas of Japan. *Land*; MDPI. <https://doi.org/10.3390/land12030592>
- Mehta, C. R., et al., (2023). Smart Agricultural Mechanization in India – Status and Way Forward. *Advanced Technologies and Societal Change*, 1–14. https://doi.org/10.1007/978-981-19-8738-0_1
- Olaniyi, O. M., et al., (2020). Weed Recognition System for Low-Land Rice Precision Farming Using Deep Learning Approach. *Advances in Intelligent Systems and Computing*, 385–402. https://doi.org/10.1007/978-3-030-51186-9_27
- Talaviya, T., et al., (2020). Implementation of artificial intelligence in agriculture for optimisation of irrigation and application of pesticides and herbicides. *Artificial Intelligence in Agriculture*, 4, 58–73. <https://doi.org/10.1016/j.aiia.2020.04.002>
- Ardiansyah, R., et al., (2021, July 1). Feasibility analysis of traditional rice farming with combine harvester in Teureubeh Village, Aceh Besar District. *E3S Web of Conferences*; EDP Sciences. <https://doi.org/10.1051/e3sconf/202130602044>.
- Indraningsih, K. S., et al., (2021). The optimization of agricultural machinery utilization in enhancing the implementation of modern agricultural programs. *IOP Conference Series*, 892(1), 012041. <https://doi.org/10.1088/1755-1315/892/1/012041>

(PDF) advanced techniques for precision farming in Rice. (n.d.). Retrieved March 26, 2023, from https://www.researchgate.net/publication/360485061_Advanced_Techniques_for_Precision_Farming_in_Rice

Diffusion of Innovation Theory. (n.d.). <https://sphweb.bumc.bu.edu/otlt/mph-modules/sb/behavioralchangetheories/behavioralchangetheories4.html>