The effect of agricultural technology on improving farming business performance and the welfare: Evidence from the welfare of rice farmers in Tabanan regency

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A B S T R A C T

This research focuses on the welfare of rice farmers in Tabanan Regency as a form of support for the sustainability of the agricultural sector to support the food security and sovereignty of Bali Province, which is still primarily supported by Tabanan Regency. This research was conducted in Tabanan Regency, Bali Province, known as the "rice barn" of Bali Province, with the largest area of rice fields and the most significant number of farmers in Bali Province. The approach used in this research is a quantitative approach using a questionnaire, and the analysis technique used in this research is SEM-PLS (Structural Equation Modeling Partial Least Square) analysis, with 167 rice farmers as respondents to this research. The findings from this research show that farming business performance can mediate the influence of agricultural technology adoption on the welfare of rice farmers in Tabanan Regency. The findings from this research are strengthened by interviews showing that rice farmers in Tabanan Regency have confidence in themselves in farming. This is demonstrated by farmers' efforts to use various developments in agricultural technology, such as using superior seeds and modern agricultural equipment, which can shorten the working time, among others, to improve the welfare of rice farmers in Tabanan Regency.

1. Introduction

Farmers' welfare supports a country's food security and sovereignty. Problems related to meeting a country's food needs arise due to the reduction in rice farming land. Limited agricultural land results in decreased production and productivity, resulting in a decline in farming business performance and the welfare of rice farmers. One of the breakthroughs that can increase production and productivity amidst land conversion is the adoption of agricultural technology, starting from cultivation technology, the use of superior seeds, the use of agricultural technology tools, and others that can save time in carrying out farming activities to improve the welfare of rice farmers. However, the welfare of farmers is still a problem that must be faced amidst the increase in rice prices and the drought phenomenon that hit Indonesia due to the El Nino storm. The increase in rice prices occurred because there were many crop failures, so the domestic demand for rice was not yet sufficient, so the amount of rice imported affected the price of rice on the market. Apart from that, there are problems related to the reduction in agricultural land and the need for more interest in the younger generation to become farmers due to the marginalization of the profession as farmers are considered less prosperous. One of the rice barns in Bali Province is Tabanan Regency. Besides that, Tabanan Regency was named a World Cultural Heritage in 2012 by UNESCO (The United Nations Educational Scientific and Cultural Organization) because of its excellent system and neatly arranged agricultural conditions. Tabanan Regency is a Regency in Bali Province with the most significant agricultural land area for rice, so it is called the Rice Granary

of Bali Province. This term is based on the largest land area; Tabanan Regency is also the largest rice producer in Bali Province. Based on the problems faced, increasing the ability of rice farmers to adopt agricultural technology in farming business performance to improve welfare is very important.

Based on the results of the National Socio-Economic Survey (Susenas) conducted in September 2017, it shows that 32.88% of poor households in Indonesia are households working in the agricultural sector, the remaining 39.18% and 27.94% respectively come from residents who do not work in agriculture, those who work and those who do not work in agriculture. Based on BPS 2020 data in September 2020, the poverty rate was 10.19%, equivalent to 27.55 million people, compared to September 2019, the number of poor people increased by 2.76 million. Judging from the primary source of income, most poor households work in the agricultural sector, namely 46.30%. The reason is that the income of farmers and farm workers is relatively low compared to other sectors. Based on BPS data (2021), the average daily wage for agricultural workers in 2021 is IDR. 57,081, while the daily salary for construction workers is Rp. 91.236. Apart from the daily wages of farmers being lower than those of construction workers, the real wages of agricultural workers also decreased by 0.26% compared to 2020. Low income in the agricultural sector means the resources spent are not commensurate with the results achieved. Farmers, to increase production results in a context of low farmer incomes, need advice and support in selecting seeds, the planting process and the distribution process of production results (Gardner, 1992; Ahearn, 1998). This is supported by research by Lin et al. (2022), which shows that agricultural policies aimed at increasing agricultural output are strengthened by developing an agricultural socialization service system related to fertilizer selection through agricultural extension. Research by Hoang et al. (2006) also recommends the role of agricultural extension institutions in providing knowledge related to the use of agricultural technology to increase production productivity. Other research that supports this is Managanta (2020) and (Maryani et al., 2017), who argue that agricultural extension institutions are a way to connect farmers with sources of information and find solutions to increase their skills and income. Below is presented the data

Several phenomena faced by farmers related to agricultural technology are the first problem related to increasing farmer competence in adopting agricultural technology, considering that most rice farmers in Tabanan Regency have exceeded their productive age. The second problem is that the agricultural equipment assistance provided by the government still needs to be solved to resolve the problems rice farmers face during the production process. The assistance equipment provided is different from the geographical conditions of the rice farming area in Tabanan Regency. Apart from that, in its operation, such as rice harvesting equipment assistance is more suitable for use on flat and wide agricultural land, whereas the characteristics of rice agricultural land in Tabanan Regency are mostly terraced, so that It takes more time to move the equipment and also requires 5 to 10 people to lift the equipment. Hence, the option is to increase farmers' ability to adopt agricultural technology which continues to develop from time to time. Based on the description above, researchers want to examine how the influence of technology adoption can improve the welfare of rice farmers in Tabanan Regency through farming business performance.

The novelty of this research is the use of food security indicators in farmer welfare variables, where there has been no previous research that combines food security indicators in measuring the welfare of rice farmers. The study by Albert and Hannel's (2005) shows that the indicators have not been combined with the Central Statistics Agency indicators generally used to measure welfare.

2. Literature Review and Hypothesis

2.1 Theory of Planned Behavior

The theory of planned behavior is used as the grand theory that underlies the framework of this research. The theory of planned behavior is a theory developed by Ajzen (1991) which explains that changes in a person's behavior can be formed. This theory is used as the basis for research. Namely, the adaptation behavior of a person in this research is a farmer towards the use of agricultural technology, and adapting the production process to technological advances is a behavior that can be planned. This behavior change is needed to support the success of the production process as a new learning method amidst the decreasing number of rice farming areas in Tabanan Regency. Rice farmers must adapt to agricultural technology so that the technology adoption process can run well and with quality.

2.2 The Effect of Adopting Agricultural Technology on Welfare of Rice Farmers

Welfare is subjective, so each family or individual with different guidelines, goals and ways of life will provide different values regarding the factors that determine the level of welfare (Badrudin, 2012). One of the factors that influences farmers' welfare is the adoption of agricultural technology, this is because the better the farmer's ability to adopt existing agricultural technology, the easier the production process will be in terms of time efficiency and increased production yields, thereby increasing the welfare of rice farmers. The results of this research are in line with research produced by Ayenew et al. (2020), Mulugeta and Heshmati (2023) stated that adopting agricultural technology will increase agricultural productivity which will be able to improve the welfare of farmers. Other research by Ogundari and Bolarinwa (2019), Chen et al. (2021) show that the adoption of agricultural technology in the context of agricultural production includes working with simple (manual) tools into modern agricultural machines or equipment, natural resource management, weed and pest control techniques, integrated agricultural techniques, and conservation agriculture. Among the potential drivers of agricultural productivity, the adoption

of agricultural technology is the most important because the use of agricultural technology is developed to increase agricultural yields, improve the quality of agricultural production, increase farmers' income, and ensure food security. The same results obtained by Kinuthia and Mubaya (2017) state that the production process that adopts agricultural technology can increase the amount of production without increasing the amount of agricultural land, as well as in terms of using agricultural technology in determining superior seeds that have higher selling power so that they can directly improve the welfare of farmers. According to Awotide et al. (2016), the adoption of better agricultural technology has the potential to deepen the market share of agricultural products using resources and diversification of agricultural products, so increasing agricultural productivity depends on the adoption of technology to increase production and farmer innovation. Apart from the adoption of agricultural technology related to agricultural tools, there are results of research related to the adoption of technology in the aspect of irrigation carried out by Ehiakpor et al. (2019) who obtained the results that the adoption of agricultural technology called Zai technology, namely Zai, is a technology used to rehabilitate degraded agricultural land and restore soil fertility, which is beneficial for farmers who primarily live on dry land, thereby increasing production results and farmer welfare.

H₁: *Adoption of agricultural technology has a positive effect on the welfare of rice farmers.*

2.3 The Effect of Adopting Agricultural Technology on Farming Business Performance

Adoption is also defined as a person's mental process from hearing and knowing about an innovation to finally adopting it. Furthermore, according to Mosher (1991), innovation adoption is a process of demonstrating, considering, and ultimately rejecting or practicing a particular innovation. The adoption of technology, especially agricultural technology, is an essential component in improving farming business performance; this is because the production process in rice farming becomes more accessible with the help of agricultural technology. The convenience in question comes from the process of adopting agricultural technology such as the use of superior seeds which are able to provide results with higher selling value, as well as adoption related to the use of more sophisticated production facilities such as rice planting machines, rice harvesting machines and pest spraying equipment which are no longer manual but using batteries, and adopting other technologies that can make farmers' work easier and more efficient in allocating work time in the fields so that they will be able to improve farming business performance (Fernandez-Cornejo, et al., 2007). The research results of Srivetbodee and Igel (2021) state that by adopting agricultural technology, farmers can increase the knowledge used in production to improve the performance of farming businesses.

H₂: *Adoption of agricultural technology has a positive effect on farming business performance.*

2.4 The effect of Farming Business Performance on the Welfare of Rice Farmers

Farming is the result achieved from agricultural activities by using all production factors owned to produce maximum agricultural production (Rivai, 1980). Farming is carried out by utilizing natural resources, labor, capital and technology to work on agricultural land so that the production results can increase their income, leading to increased welfare. Increasing the performance of farming businesses will encourage additional agricultural production, which will impact farmers' welfare. The research results of Situmorang et al. (2020) and Hassan, et al. (2020) obtained the results that the availability of production factors must be maintained in agricultural business performance so that in the process of improving business performance there are no obstacles in the production process so that production results, sales and income increase so that farmers' welfare will automatically increase.

H₃: *Farming business performance has a positive effect on the welfare of rice farmers.*

2.5 The effect of adopting agricultural technology on the welfare of rice farmers through farming business performance

Farming business performance can improve farmers' ability to adopt agricultural technology so that farmer welfare will also increase. This is because good farming performance will encourage farmers to adopt forms of agricultural technology to obtain convenience during the production process, time efficiency and better production results which will impact increasing income. Research results from Efendy and Balai (2014), Ninomiya (2004) and Hatta et al. (2017) found that good farming business performance will be able to mediate the process of adopting agricultural technology so that farmers' welfare will increase.

H₄: *Farming business performance can mediate the influence of agricultural technology adoption on the welfare of rice farmers.*

3. Methods

3.1 Types of Research

This quantitative research uses a structural equation modelling approach to prove the hypothesis using SmartPLS software. This research examines the relationship between one variable, namely the variable being explained, and the explanatory variable through one intermediary variable. This research aims to test hypotheses formed from theory and previous research results.

3.2 Research Variables

This research consists of three variables: independent, dependent, and intermediate. The dependent variable in this research is the welfare of rice farmers. Welfare is an organized system of social services and institutions, which aims to help individuals and groups to achieve satisfactory standards of life and health, as well as individual and social relationships that enable them to develop their full abilities and improve the welfare of farmers in harmony with the needs of the family and community (Rukminto, 2013). According to Albert and Hannel (2005) and the Central Statistics Agency (2000), there are seven indicators to measure the welfare of rice farmers, namely: income structure, expenditure on food, purchasing power of farming households, food security of farming households, ease of enrolling children in education, ease of obtaining health services, condition of house or residence.

The independent variable in this research is the adoption of agricultural technology, where the adoption of agricultural technology is the process of a person's acceptance of a novelty in the form of technology in the agricultural sector (Burhan et al., 2018; Efendy & Balai, 2014; Ninomiya, 2004). According to Rogers (2003) and Mosher (1991), the indicators used to measure the adoption of agricultural technology are usefulness (usefulness), compatibility (level of suitability), complexity (level of complexity), triability (can be tried), observability (can be observed).

The intervening variable in this research is farming business performance. Farming business performance is the achievement or output of both quality and quantity achieved by farmers per unit of time in carrying out their farming activities (Puspitasari et al., 2019). In this research, farming business performance uses four indicators by Jauch and Glueck (1998): production, sales, and operating profit.

3.3 Hypothesis Testing Stages

Data from answers to research questionnaires are summarized, and information is provided regarding the number of respondents, gender, and level of education. Data quality was checked using validity and reliability tests for 167 respondents. Validity checks are carried out to ensure the validity of the data and that each statement in the questionnaire appropriately represents the variables studied. Reliability tests have been carried out to ensure the consistency of 167 respondents in answering. Hypothesis testing is carried out in two stages: direct influence testing and indirect influence testing. This research will test three hypotheses regarding direct influence and one hypothesis regarding indirect influence. They proved this hypothesis using Smart PLS software.

This research uses primary and secondary data. Collecting data and information required for analysis by 1) study documentation aimed at obtaining secondary data owned by the relevant agencies; 2) field observation, namely direct observation of the research location; 3) structured interviews are data collection techniques using a list of questions that have been prepared previously related to the variables studied; 4) in-depth interviews conducted with key informants to support quantitative study analysis such as subak heads, field agricultural instructors. In-depth interviews are conducted in an unstructured, flexible manner in an informal atmosphere and can be carried out repeatedly (Sugiyono, 2017, p. 220).

4. Findings

4.1 Data Feasibility Test

The population in this study were rice farmers in Tabanan Regency, Bali Province, totaling 2,576 rice farmers, spread across 10 sub-districts (Selemadeg, Kerambitan, Tabanan, Kediri, Marga, Baturiti, Penebel, Pupuan, West Selemadeg, and East Selemadeg). A total of 167 rice farmers were selected as research respondents to answer the questionnaire.
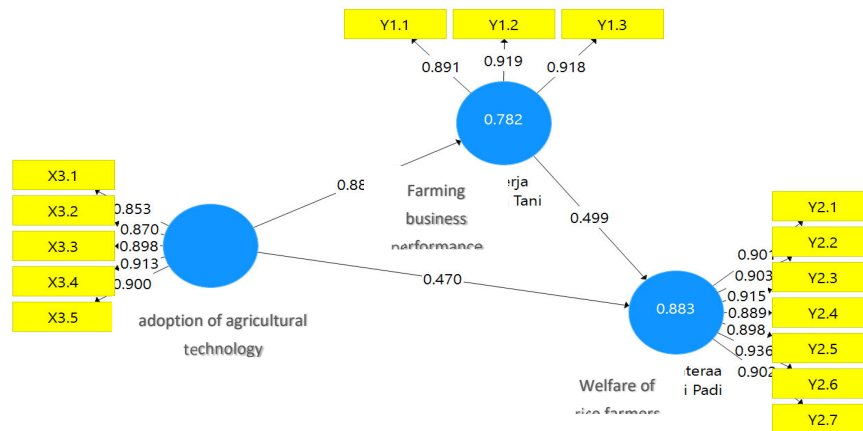

Fig. 1. Validity Test

Source: Smart PLS, 2023

Fig. 1 shows that all indicators for each variable have a loading factor value above 0.5, so it can be concluded that the statement instrument made in the research questionnaire is valid and worthy of representing the variables studied. The results in Figure 1 above also provide information that the coefficient of determination of farming business performance is 0.782 or 78.2%, which means that 78.2% of the agricultural technology adoption variable can explain farming business performance, while other variables outside the model explain 21.8% in this research. The coefficient of determination of rice farmers' welfare is 0.883 or 88.3%, which means that 88.3% of the variables of agricultural technology adoption and farming business performance can explain the welfare of rice farmers, while other variables outside this research model explain 11.7%.

4.2 Hypothesis Testing

Hypothesis testing is divided into two, namely direct influence testing and indirect influence testing. The direct effect test was carried out to test the three hypotheses in this research. Meanwhile, the indirect effect test was carried out to answer one hypothesis in this research. The following are the results of the direct influence test.

Table 1
Direct Effect Test

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Adoption of Agricultural Technology → Welfare of Rice Farmers	0.470	0.465	0.058	8.088	0.000
Adoption of Agricultural Technology → Farming Business Performance	0.884	0.884	0.017	52.806	0.000
Farming Business Performance → Rice Farmer Welfare	0.499	0.503	0.058	8.600	0.000

Based on the table above, conclusions can be drawn regarding the direct influence test as follows; First, the adoption of agricultural technology has a positive and significant influence on the welfare of rice farmers with an original sample value of 0.470 and a P-value of 0.000 < 0.05 which supports these results, so the first hypothesis in this research is proven and accepted. The findings of this research strengthen and complement the research results of Ayenew et al. (2020), (Mulugeta and Heshmati (2023), and Chen et al. (2021), who obtained that the adoption of agricultural technology had a positive and significant effect on farmers' welfare. This means that all efforts to adopt agricultural technology will significantly impact farmers' welfare.

Second, the adoption of agricultural technology has a positive and significant effect on farming business performance with an original sample value of 0.884 and a P-value of 0.000 <0.05 which supports these results, so the second hypothesis in this research is proven and accepted. The findings of this research strengthen and complement the results of Ainembabazi et al. (2017) and Khanal et al. (2018), who found that adopting agricultural technology had a positive and significant effect on farming business performance. This means that all efforts to adopt agricultural technology will significantly impact farming business performance.

Third, farming business performance has a positive and significant influence on the welfare of rice farmers, with an original sample value of 0.499 and a P-value of 0.000 <0.05, which supports these results, so the third hypothesis in this research is proven and accepted. The findings of this research strengthen and complement the research results of Ramdhani et al. (2015), Hassan et al. (2020), and Jääskeläinen et al. (2014), who obtained that the results of farming business performance had a positive and significant effect on farmer welfare. This means that all efforts to improve farming performance will significantly impact farmer welfare.

Table 2
Indirect Effect Test

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Adoption of Agricultural Technology → Farming Business Performance → Rice Farmer Welfare	0.441	0.445	0.052	8.427	0.000

Based on the table above, conclusions can be drawn regarding the direct indirect effect test as follows; Farming business performance is able to mediate the influence of agricultural technology adoption on the welfare of rice farmers with an original sample value of 0.441 and a P-value of 0.000 <0.05 which supports these results, so the fourth hypothesis in this research is proven and accepted. The findings of this research strengthen and complement the results of research (Burhan et al., 2018; Efendy & Balai, 2014; Ninomiya, 2004; Hatta, et al., 2017) which obtained results of farming performance being able to mediate the influence of agricultural technology adoption on farmer welfare. This means that all efforts to improve farming performance will have an impact on the influence of agricultural technology adoption on farmer welfare.

5. Conclusions and Discussion

The first results of this research show that the adoption of agricultural technology has a positive and significant effect on the welfare of rice farmers. This means that adopting agricultural technology will increase agricultural productivity and improve the welfare of farmers. The second result shows that the adoption of agricultural technology has a positive and significant effect on farming business performance. This means that good mastery of agricultural technology can increase the success of agricultural development, and therefore, the process of adopting agricultural technology is very important, especially in improving the performance of farming businesses. The third result is that farming business performance has a positive and significant influence on the welfare of rice farmers, which means that an increase in farming performance, which can be measured by increasing production yields, increasing sales volume, and increasing income, will be able to improve farmer welfare. The fourth result of this research shows that the results of farming business performance are able to mediate the influence of agricultural technology adoption on farmer welfare. This means that all efforts to improve farming performance will have an impact on the influence of agricultural technology adoption on farmer welfare.

The ability of farmers to adopt agricultural technology is very important considering the limited agricultural land caused by land conversion which has increased in Tabanan Regency, because the better the ability of farmers to adopt agricultural technology, the better the farmer's welfare will be. The adoption of agricultural technology has so far been proven to help farmers make their work easier and increase agricultural production capacity in various land conditions so that it can continue to improve farmer welfare. Suggestions to the government and related agencies to focus more on agricultural technology provided that is appropriate and on target, as well as continuity in providing counselling and training related to the use of agricultural technology for rice farmers in Tabanan Regency.

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