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Enhancing Onion Cultivation in Indonesia: AMOS Analysis of Technology Adoption in South Sulawesi and East Java

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ABSTRACT

Background: The adoption of agricultural technology contributes a vital role in increasing the use and profitability of agricultural resources.Strategic commodities, such as onions, should receive special attention in technology development to increase production to support the Indonesian economy. This study aimed to analyze the effectiveness of using AMOS in discussing technology adoption in onion cultivation.

Methods: The research method was carried out using the Structural Equation Modeling (SEM) approach, with the solution using the Analysis of Moment Structures (AMOS).The research was conducted in the Provinces of South Sulawesi and East Java, focusing on Enrekang Regency, South Sulawesi Province and Nganjuk Regency, East Java Province, each covering two sub-districts, resulting in a total of four sub-districts.

Result: The results showed that onion farmers in South Sulawesi and East Java were relatively more adaptive to adopting agricultural technology, as indicated by the hypothesis testing results.The CR values for H1 was 0.043 and H2 -0.041.

Key words: Adoption, Agriculture, AMOS, Onion, Technology.

INTRODUCTION

The Onion Plant is Indonesia's national strategic commodity, as stated in the Regulation of the Minister of Agriculture of the Republic of Indonesia Number 46 of 2019 concerning the development of strategic horticultural commodities.

Onions also serve as a reference for inflation. In July 2022, onions, Chilli and cayenne pepper triggered an inflation rate of 0.64%.Strategic commodities, such as onions, should receive special attention in technology development to increase production to support the Indonesian economy.

Technological adaptation holds promise in increasing resource use and agricultural profitability.Various available agricultural technologies can strengthen managerial decision-making abilities, thus enabling agricultural operations to use resources more efficiently and reduce risks.Farmers' access to agricultural technology has long been recognized as necessary to improve their livelihoods.Therefore, access to agricultural technology is necessary for long-term agricultural development.In Indonesia, the level of technology adoption for farmers is significant for agricultural and economic growth, which can be seen from empirical evidence that technology can increase farmers' income, but farmers have not fully absorbed it. The use of technology in agriculture requires a mature mastery of the actors in the agricultural sector (Ruzzante *et al*., 2021; Nagarajan *et al*., 2024).

However, the growth of the agricultural sector depends on the introduction of better, large-scale and environmentally friendly technologies, including new disease-resistant technologies, the use of superior seeds, modern management practices and resource conservation. Therefore, the key to agricultural growth is the adoption of agricultural technology, which still has obstacles because of the many factors that influence the adoption process (Suman *et al*., 2017; Mottaleb, 2018). The existence of new agricultural technology raises risks and uncertainties about the feasibility of its application, the suitability of scale and suitability with the prevailing environment and most notably, with the perceptions and expectations of farmers. Therefore, assessing farmers' perceptions of new agricultural technologies is essential to ensure technology adoption and improvement, sustainable growth and development of the agricultural sector (Beula *et al*., 2016; Mottaleb, 2018; Patra and Bharti, 2024).

In most cases, technological change, technology adoption and agricultural commercialization are similar.The food security of communities and countries depends on the productivity of their agricultural systems. Technological changes in agriculture have long been

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accepted as a necessary condition for accelerating the growth of food production (Sharma *et al*., 2022).Adopters of yield enhancement or postharvest technologies are more likely to experience higher production per unit of land and associated income benefits at the household level than non-adopters. The desired benefits of technological change, such as increased production and income from agriculture or food, are expected to positively influence household food consumption and nutritional adequacy (Babu *et al*., 2022).

The relationship between the changing use of agricultural technology and efforts to increase production in order to achieve food security goals is complex.New technologies have indirect and partial effects; therefore, a focused approach is needed to unravel the complexity of the relationship.This is important for the provinces of South Sulawesi and East Java to increase the food security of onion plants. First, it can meet basic food needs for a more stable rural economy and second, as a commercial crop with local wisdom that is agro-technologically suitable for increasing sustainable production yields (Babu *et al*., 2022).

The relationship of all factors of technological adaptation to the onion commodity will be analyzed more deeply using the SEM approach, which is more capable of analyzing data more comprehensively than path analysis and multiple regression (Ratnam *et al*., 2024). Data analysis for path analysis and multiple regression was performed only by calculating the total score (score) between the variables examined and determining the number of examination instruments.Therefore, path analysis and multiple regression were tested only at the level of latent (unobserved) variables. At the same time, the data analysis of the SEM method can be tested in-depth and thoroughly because it is conducted for each question score of the research tool variable.Statements in the SEM analysis tool are also known as explicit (observed), constructed, or latent variable indicators (Junaidi, 2021). This study aimed to analyze the effectiveness of using AMOS in discussing technology adoption in onion cultivation.

MATERIALS AND METHODS

Sample and data collection

The research was conducted in the Provinces of South Sulawesi and East Java, focusing on Enrekang Regency, South Sulawesi Province and Nganjuk Regency, East Java Province, each covering two sub-districts, resulting in a total of four sub-districts. The location of the sample districts was determined purposively and the sample districts were determined intentionally (purposive sampling). The basis for site selection was high and low productivity. The study was conducted from July to October 2022. From each sample sub-district, 30 farmers were selected as respondents at random in stages (multistage random sampling) following (Hendayana *et al*., 2007); thus, a total of 120 samples were taken.

Instrumentation

Data collection used a structured instrument (questionnaire) that has been tested for validity and reliability (Taherdoost, Business, Sdn, Group and Lumpur, 2016). Each item was rated on a Likert scale. Five-point scale with responses ranging from “1=strongly disagree” to “5=strongly agree.”

Methods

The structural equation Modeling (SEM) approach was used to answer the research objectives, with the solution using Analysis of Moment Structures (Amos) version 16. Structural equation modeling (SEM) is a statistical tool for evaluating predefined assumptions about causal relationships between measurable and latent variables. SEM is also a standard method for statistical analysis. Examining the relationships between variables is one of its advantages over other quantitative methods (Syafiq and Purwoko, 2022). SEM is a multivariate statistical analysis technique that combines factor analysis, which is equivalent to path analysis, regression/correlation analysis, or simultaneous equation modeling (Rosseel, 2012). Using SEM analysis, the relationships between variables that exist in a model, indicators and their constructs and relationships between constructs are tested (Kaliky *et al.*, 2015). SEM analysis has two main parts: (1) testing the validity of the measurement model (measurement model) and (2) testing the validity of the structural model (structural model). The measurement model is a part of the SEM model, which consists of a latent variable (construct) and several manifest variables (indicators) that explain the latent variable.The test aims to determine the accuracy of the manifest variables in explaining existing latent variables.The causal relationship was causal.Thus, we consider the exogenous (influenced) and endogenous (influenced) variables.The endogenous variable in this study is technology adoption (Y), with three indicators: the level of adoption of innovative technology, acceleration of technology adoption time and duration of technology adoption.In comparison, the exogenous variables in this study were technology services (X1) and technology availability (X2), with six indicators: variety, quality, price accuracy, timeliness, place suitability and quantity per hectare suitability (Table 1 and Table 2).

RESULTS AND DISCUSSION

The results show that Fig 1 shows the AMOS model built from the exogenous and endogenous variables.The exogenous variable (the influencing variable) is technology adoption (Y), with three indicators: the level of innovative technology adoption, acceleration of technology adoption time and duration of technology adoption. The choice of this indicator strengthens the research of (Adawiyah, 2017), which states that technology adoption, acceleration of adoption time and length of adoption are diffusion processes of communication in agriculture. Table 2 presents the intercept results for the variables used in this study.In comparison, the exogenous variables in this study were technology services (X1) and technology availability (X2), with six indicators: variety, quality, price accuracy, timeliness, place suitability and quantity per hectare suitability.This indicator supports the findings of (Syamsuddin, 2019).

Results of Structural Model Test of the Proposed Theoretical Framework.This model is based on the established criteria (Fig 2). The hypothesis test results showed that, in total, two hypotheses were tested. The first hypothesis estimates technology services on adoption (H1) and technology availability on adoption (H2). From the results of the hypothesis testing, the C.R value for H1 is 0.043 and that for H2 is -0.041. Both hypotheses were not significant because they had a C.R value less than 1.98 (Table 3).

The hypothesis of this study assumes the influence of technology services on farmer adoption.The AMOS calculation produced a C.R value of 0.043, which indicates that this hypothesis is not significant. The rejection of this hypothesis is caused by the perception of farmers on adopting agricultural technology in terms of the technology services provided, which have been widely accepted to form a pattern of farmer independence. The results of this study strengthen those of (Mustaha, 2022) and (Sarwendah, 2014). Technological services are needed to develop the agricultural sector. This service is expected to increase food security and competitiveness to support the realization of advanced, independent and modern Indonesian agriculture. To achieve the goal of advanced, independent and modern agriculture, it is crucial to implement downstream technological innovations according to the current needs of stakeholders.

Martini (2021) revealed the benefits of agricultural technology services by providing high-quality, independent and certified onion seeds Muhammad (2018) also revealed that the provision of technology services to vegetable farmers would increase the knowledge of the farming community to increase the productivity of onions so that competitiveness in the horticulture sector can be maximized Setiawati (2005) emphasized the strategy of developing a onion agribusiness system through the development and improvement of innovative technology services Syamsuddin (2019) revealed

Table 1: Hypothesis test results.

Hypothesis	Path			C.R.	P	Result
H_1	Service	→	Adoption	0.043	0.966	not sig
H_2	Availability	→	Adoption	-0.041	0.967	not sig

Table 2: Intercept model amos.

Variable	Estimate	S.E.	C.R.	P	Result
VS	3.8167	.0837	45.6164	***	Sig.
QS	3.7167	.0769	48.3540	***	Sig.
PS	3.0917	.1129	27.3862	***	Sig.
TS	3.5750	.0791	45.2016	***	Sig.
LS	3.8250	.0808	47.3147	***	Sig.
QtS	3.6250	.0991	36.5944	***	Sig.
VA	3.5750	.1016	35.1967	***	Sig.
QA	3.7417	.0789	47.3974	***	Sig.
PA	3.5417	.0861	41.1477	***	Sig.
TA	3.0583	.0978	31.2706	***	Sig.
LA	3.6750	.0830	44.2883	***	Sig.
QtA	3.7250	.0828	44.9825	***	Sig.
AT	3.9167	.1181	33.1646	***	Sig.
Ac	2.3333	.0779	29.9513	***	Sig.
AR	2.4667	.1141	21.6201	***	Sig.

VS: Varieties services, QS: Quality service, PS: Price service, TS: Time service, LS: Location service, QtS: Quality service, VA; Varieties availability, QA: Quality availability, PA: Price availability, TA; Time availability, LA: Location availability, QtA: Quality availibility, AT: Adoption time, Ac: Accelaration and AR: Adoption rate.

Table 3: Covariancess variabel value.

Variabel			Estimate	S.E.	C.R.	P	Result
S	<-->	A	.4872	.0928	5.2477	***	Sig.

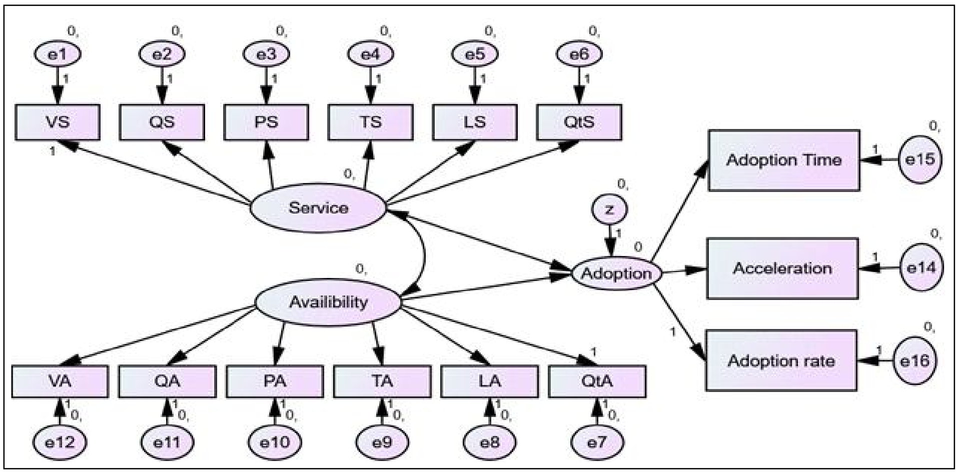

Fig 1: Amos model.

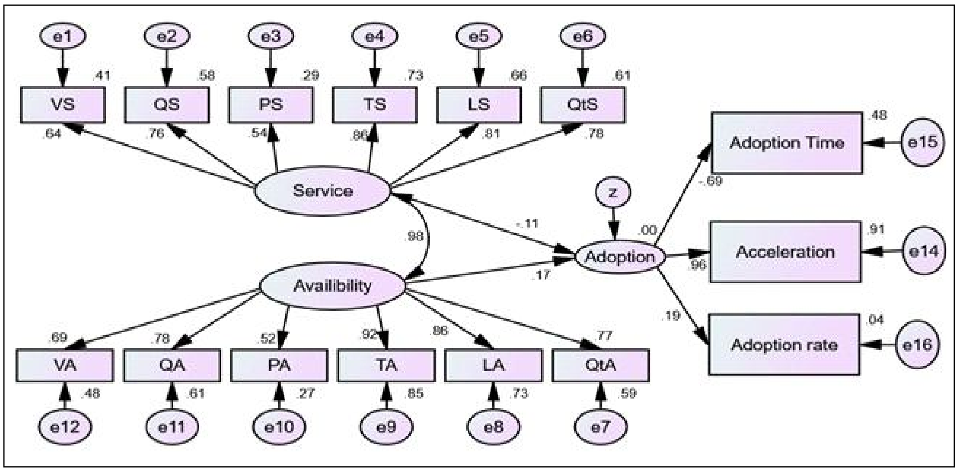

Fig 2: Structural model of theoretical framework test.

the role of the government and extension workers in empowering the community to improve family welfare through outreach activities.

The hypothesis of this study assumes the influence of technology availability on farmer adoption. The AMOS calculation produced a C.R value of -0.041, which indicates that this hypothesis is not significant. This hypothesis is not significant because vegetable farmers easily access agricultural technology from production facilities to the free market, thus causing a relatively weak dependence on agricultural technology facilities. The results of this study strengthen the research of Bahrun and Adhi (2022), who revealed the influence of intention on farmers' decisions in onion cultivation. Priantika (2019) revealed many actors in the onion agribusiness chain.

Iriani (2013) revealed the perception of technology for the availability of quality onion seeds (Tahyudin *et al*., 2020) revealed the behavior of onion farmers in onion cultivation (Adi *et al*., 2016) also revealed that the role of farmer groups is a factor in access to onion farming technology.Research from (Seran and Taena, 2019) revealed that the percentage of technology used in onion farming is high, with a value of 76.38%.

CONCLUSION

The results showed that onion farmers in the provinces of South Sulawesi and East Java were relatively more adaptive in adopting agricultural technology, as indicated by the results of hypothesis testing, with the C.R value for H1 being 0.043 and H2 being -0.041. Onion farmers in Indonesia have been optimally developed.Horticultural farmers are more advanced than food crop farmers in terms of access to technology.

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Conflict of interest

All authors declare that they have no conflict of interest.

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