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A Systematic Literature Review: UTAUT Model Research for Green Farmer Adoption

Zaenal Arifin Siregar [a,b,*], Sutrisno Anggoro [c], Hari Eko Irianto [d], Hartuti Purnaweni [a]

[a] *Department of Environmental Science, School of Doctoral Studies, Diponegoro University, Semarang, Indonesia*
[b] *Indonesian Research Institute for Fisheries Postharvest Mechanization, Ministry of Marine Affairs and Fisheries, Bantul, Indonesia*
[c] *Faculty of Fisheries and Marine Science, Diponegoro University, Semarang, Indonesia*
[d] *Research Center and Development for Marine and Fisheries Product Processing and Biotechnology (BBP4BKP), Ministry of Marine Affairs and Fisheries, Jakarta, Indonesia*
*Corresponding author: *zaenalarifinsiregar@kkp.go.id*

***Abstract*—Increased food production necessitates technological adoption. Model adoption is a term that refers to the Unified Theory of Acceptance and Use of Technology (UTAUT). The model development research seeks to identify critical variables influencing technology adoption. The development objective is to accelerate the adoption of innovative technology. A literature study is used to develop the UTAUT model and identifies significant factors. SALSA was utilized to conduct this literature review (Secondary Appraisal, Synthesis, and Analysis). The analytical technique employed is a meta-analysis, with the findings shown as a forest plot. Three hundred ten journals were collected for this study evaluation, with 11 selected for further examination. Currently, 13 models are being used in selected journals to modify the UTAUT model. Much of the research in Asia is conducted in research sites. In comparison to the modified UTAUT model, the UTAUT model has the most significant association with technology adoption (0.432). On the other hand, that model exhibits a high degree of heterogeneity (81.5%). Behavioral Intention (0.384) is a component of the UTAUT model, with considerable variability seen in the data (70.3%). Agriculture interventions must be directed at boosting the use of technology. A farmer may engage the services of a mediator following the UTAUT paradigm. Three critical factors to examine are Performance Expectancy, Social Influence, and Facilitating Condition Factors.**

***Keywords*—Literature review; farmer; model; UTAUT; meta-analysis.**

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I. INTRODUCTION

Multiple studies on technology adoption are already conducted utilizing the Unified Theory of Acceptance and Use of Technology (UTAUT), which encompasses all aspects of technology adoption, from firm-specific characteristics to adoption in response to health issues [1] to government service [2], [3]. One of the crucial things is the adoption of technology to strengthen food productivity. The number of humans will determine the need [4]. The population will affect the growth of the planet Earth [5], [6]. Farmers are essential to Foodland management [7], [8]. This fact does not make the number of farmers increase. There is a decrease in farmers' number [9], [10] and using simple technology [11], especially in Indonesia. Technology is one of the solutions to increase food production [12].

New and sophisticated technology requires effort to be adopted by farmers [13]. Many factors affect farmers' adopt new technology. Psychological factors, socioeconomic factors, and external factors determine the adoption of sustainable agriculture [14]. Economic factors are essential affected farmers to adopt a technology based on socioeconomics study [15], [16]. Socioeconomic factors in adoption research are more widely used than psychological factors, although socioeconomic factors do not adequately present farmer character [14]. Psychological factors such as user perceptions are more commonly used in the adoption of information technology, such as the Technology Acceptance Model (TAM) [17], and evolve into UTAUT [18],[19].

The UTAUT model was chosen for this literature review because it incorporates precedent technology acceptance paradigms [20]. UTAUT is based on several different technology acceptance models, including the Technology Acceptance Model (TAM), the Technology Planned Behavior (TPB), and the Technology Acceptance Model (TAM) (TPB). In this model, Use Behavior is determined by Performance

Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Condition (FC), and Behavioral Attention (BI) [17]. These variables were modified by gender, age, experience, and volunteering [21].

Decreased food and agricultural output are one of the future's greatest problems [22], [23]. To meet future food demands, the farmer must utilize technology to expand food production. Therefore, it is necessary to experimental factors that can influence farmer adoption use of technology [24], [25]. A literature study was undertaken in research journals regarding the UTAUT adoption model in farmers and conducted a meta-analysis on the UTAUT factors correlated with farmer adoption. The results obtained are supposed to help precipitate farmers adopting technology to fulfill food production. The meta-analysis review method uses to synthesize the effects of technology acceptance research by farmers using the UTAUT model. Meta-analysis is used for systematic reviews to elucidate research questions quantitatively, utilizing a set of statistical methods to synthesize the results of various studies [26].

This study has two main contributions. First, it combined deductive and inductive methods to identify substantial factor adoption farmers use green farmer in UTAUT model. Second, 11 papers were derived from reputable journals and used to explain the factors that affect the adoption. For that objective, the study contains four sections: the background of the study and technology adoption using the UTAUT model review (section 1). Method study for reviewing the literature and meta-analysis of adopting the UTAUT model (section 2). The study article results in identity and collection, interpretation and discussion (section 3), and conclusions from literature studies (section 4).

II. Material and Method

The study was conducted using the Systematic Literature Review (SLR) method with meta-analysis analysis. The use of SLR aims to make the study's results qualitative, systematic, and explicit. This method can identify, evaluate, and synthesize research journals [27]. SLR is mainly divided into three parts: plan, implement, and report [28]. Search, Appraisal, Synthesis, and Analysis (SALSA) are SLR methods [29].

A. Search

The first step to gaining information to be collected is to search. A focused search is a strategy to get the relevant document in the database [27]. This study collected journals from databases Science Direct, SpringerLink, and Scopus. Numerous studies utilize these three databases well in this study area. They are important to the research topic of this research study, and they allow for the use of both search strings and Boolean to enhance the search process's findings [30]. Table 1 shows that the words used for search are adoption, UTAUT, and farm, using different words in the "adoption model," farm, and technology. The search is filtered based on the most recent journals, and this study defines journals as the most recent journals after 2010 or the last ten years.

TABLE I
THE KEYWORDS USED IN THE SEARCH AND THE TOTAL NUMBER OF PUBLICATIONS

Database	String Collection		No of Article	Date of acquisition
Science Direct	Principal search terms—utilizing the document's title, abstract, and keywords	adoption UTAUT farm	46	20/08/2020
	Secondary searching terms	"adoption model" farm technology	169	20/08/2020
Springer Link	Principal search terms—utilizing the document's title, abstract, and keywords	adoption UTAUT farm	31	20/08/2020
	Secondary searching terms	"adoption model" farm technology	55	20/08/2020
Scopus	Principal search terms—utilizing the document's title, abstract, and keywords	adoption UTAUT farm	7	20/08/2020
	Secondary searching terms	"Adoption model" farm technology	2	20/08/2020

B. Appraisal

The appraisal is a step in selecting journals that follow objectives at this stage using a filter based on the specified criteria [31]. The journal criteria are determined based on Table 2.

TABLE II
SELECTION OF LITERATURE FOR THE SLR STUDY USING INCLUSION AND EXCLUSION CRITERIA

Criteria	Decision
Predefined keywords appear throughout the article, or at the very least in the title, keywords, and abstract sections	Inclusion
The article was published in a peer-reviewed scientific publication	Inclusion
The article must be delivered in the English language	Inclusion
When publications discuss UTAUT and sample size	Inclusion
Duplicate documents within the search documents	exclusion
Articles that are not publicly available include review articles and meta-data	exclusion
Research articles that are neither primary nor original	exclusion
The article does not describe the coefficient UTAUT Factor	exclusion
Prior to 2010, there were many papers published	exclusion

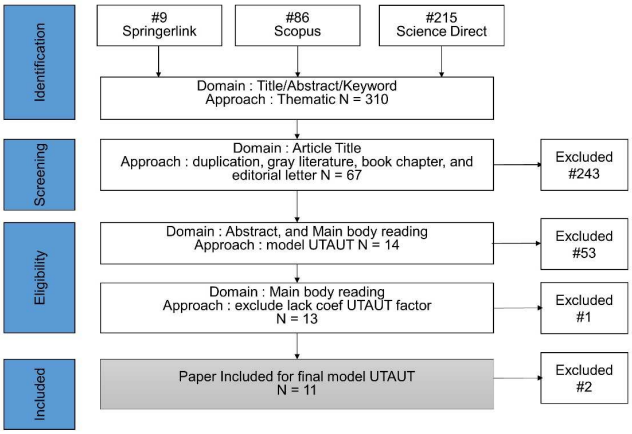

Fig. 1 The flow diagram depicts the database search process for articles relevant to systematic reviews. Source: [31]

Fig.1 displays the journal selection process. There were 310 journals from the Science Direct, SpringerLink, and Scopus databases at the search's initial stage. The first screening was filtered based on the duplication of journals, books, and gray literature, so 67 journals were selected based on the UTAUT model's journal contents. The election results were about 14 because it filters by abstract and main body, and based on the final selection, 11 journals use in this study.

C. Synthesis

Synthesis is the stage of grouping information from selected journals based on predetermined objectivity [31]. The objectivity of SLR is shown in table 3. Information data obtained from 11 selected journals are presented in tables or Figures. The synthesis operated to simplify the analysis process.

TABLE III
CRITERIA FOR EXTRACTION OF DATA FROM SAMPLED ARTICLES

No	Criteria	Categories considered	Justification
1	Publication time	After 2010	Those studies before 2010 discarded
2	Type of journal	Economy	To describe the journal about the economy, production
		Environment	To describe the journal about land use, water, agriculture
		Computer	To describe the journal about consumer technology, system information
3	Study site	Name of the continental	Geographic site
4	Model	Original	Performance expectancy, Social influence, Effort expectancy, Facilitating condition, Behavioral Intention, Use of Behavior, Gender, Age, Experience, Voluntariness to use
		Modification	Add or reduce the UTAUT factor
5	Types of Sample	Smallholder farmer	Farmer
		Industrial	Non-farmer, Industrial farm
		Other	Consumer, household farmer

D. Analysis

This study uses a meta-analysis with a forest plot to describe the results from selected journals. Forest plots were processed using Comprehensive Meta-Analysis software [32] with a random-effect model. Heterogeneity of journals Figure out with statistical value I^2 in a value of 0% indicates no heterogeneity, then the values 25%, 50%, and 75% represent low, medium, and high heterogeneity levels [33]. Journal use as a data forest plot source to obtain the UTAUT model has that correlation with adoption. Factors in the journal extracted into a new model UTAUT in forest plot to acquire the significant factor to adopt the UTAUT model's technology.

III. RESULT AND DISCUSSION

The findings of this literature review are based on the extraction of data from 11 publications, as shown in Table 3. The aim of comparisons between the information contained in the journal is to seize more information. This study provides several characteristics of journals that discuss adoption analysis using the UTAUT model for agriculture. Characteristics in this study are sampling, the type of technology adopted, the UTAUT model used, and the output.

A. General Characteristics of the Selected Literature on Analyzing Adoption Using Model UTAUT for Farm

A reduction of 299 or 3.5% of journals in the literature search met the criteria from three database journal sources. The percentage of remaining journals can be improved if the criteria for selecting journals are more manageable, while the number of journals can increase if the number of databases is enlarged or the criteria for search words use ordinary words. Three themes discover from the three database sources in 11 journals: economy, environment, and computers. Fig. 2. delineates that the journal about adopting the UTAUT model is more widely used in environmental themes.

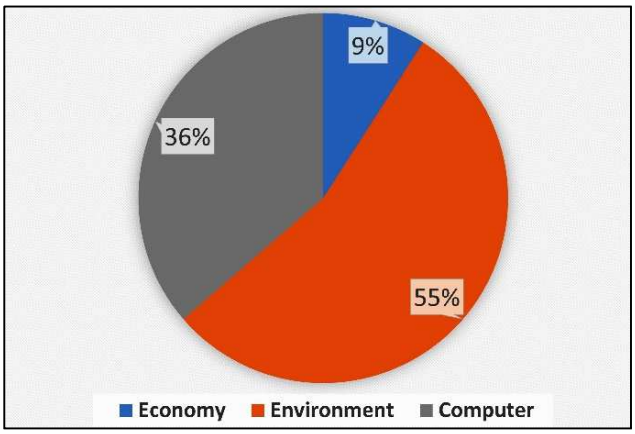

Fig. 2 Journal theme comparison on adoption using UTAUT model

The amount of 37% of the study on technology adoption among farmers is commonly conducted in Asia (Fig. 3.), case in point Iran and Malaysia. The result can be because the Asian continent is a continent that still has many farmers. Therefore, it needs the initiation of technology [34]. The technology adoption model many used is developing the UTAUT adoption model, and journals using the original UTAUT model are 18% (Fig. 4.).

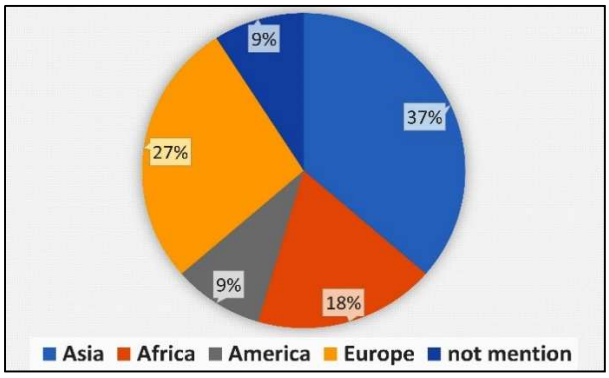

Fig. 3 Continental distribution of the journal considered for this study

The model may be used as a result of an ongoing technology adoption study to notify the appropriate variables. The variables affecting adoption in the UTAUT are as follows: Behavioral Intention, Performance Expectation, Effort Expectation, and Social Influence, as shown in Table 4. There are additional factors such as Trust factors, Market Trends, Price Value, and others to get a good model. Most of the samples taken were from farmers, and the significant sample of 1139 people came from consumers in the agricultural sector. Another sample used is the management of a company in agriculture. The technology introduced in the agricultural sector is miscellaneous such as information technology, environment, and energy.

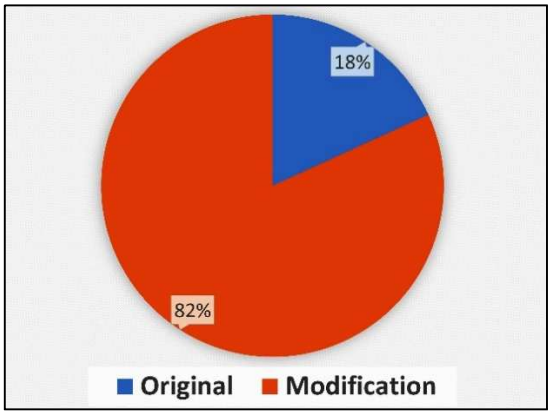

Fig. 4 The model used in the journal

TABLE IV
JOURNAL SELECTION RESULTS BASED ON PREDETERMINED CRITERIA

No	Output	Sample	Sample Type	Technology	Source
1	Technology readiness, technological integration, global scope, managerial obstacles, competitive pressure, market trends expectations, trust, information sharing, partner power, performance expectancy, effort. expectancy, social influence effect to evaluation, adoption, routinization	505	Industrial	e-Supply chain	[35]
2	Initial trust, behavioral intention, adoption affected by firm reputation, propensity to trust, perceived structural assurance, performance expectancy, effort expectancy, perceived cost, facilitating conditions	538	Smallholder farmer	Water and soil conservation measures	[36]
3	Behavioral intention effected by performance expectancy, effort expectancy, trust, price value	220	Smallholder farmer	mobile Short Message Service	[37]
4	Use behavior effected by behavioral intention, facilitating condition, behavioral intention, effected by performance expectancy, social influence	210	Industrial	pressurized irrigation technology	[38]
5	Use behavior effected by behavioral intention, facilitating condition, behavioral intention, effected by performance expectancy, social influence, resistance to use, effort expectancy, facilitating condition	564	Industrial	Big Data	[39]
6	Behavioral intention, effected by performance expectancy, effort expectancy, facilitating condition, price value, habit, trust, moderating by gender	215	Industrial	e-commerce	[40]
7	Intentional to plant affected by social influence, planting experience, performance expectancy, effort expectancy, intentional to plant affected by social influence, risk expectancy, planting experience, performance expectancy, female interaction term, parcel size, buffer to nearest road	137	Smallholder farmer	multifunctional agroforestry	[41]
8	Behavioral intention effected by performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, habit, moderating by age	1139	Other	Community Supported Agriculture	[42]
9	Intention affected by awareness, perceived behavioral control, relative advantage, moral norms, intention affected by awareness, relative advantage, moral norms mediated by the attitude	280	Other	renewable energy	[43]
10	Intention to adopt affected by social influence intention to continue affected by perceived ease of use, perceived usefulness	553 non-User 191 User	Smallholder farmer	mobile application	[44]
11	Adopt affected by facilitating condition, behavioral intention behavioral intention effected by performance expectancy, effort. expectancy, social norms performance expectancy effected by effort expectancy, social norms	207	Smallholder farmer	mobile application	[45]

B. Forest Plot and Heterogeneities

Two forest plots are generated as a result. They compare models in the journal and the UTAUT model's factors. Fig. 5. displays the results of a meta-analysis from a forest plot between the models in the journal. The total number of all models compared is 14 models. There is more model because there is a journal with more than 1 model. Two models have a p-value greater than 0.05, meaning that the results are insignificant. Overall, the model has factors that positively correlate with interpretation adoption. The model with the

enormous number (0,432) correlation is the model [38]. The heterogeneity value (I^2) for the forest plot was 81.5%, with a p-value <0.01, so it indicates high heterogeneity (greater than 75%).

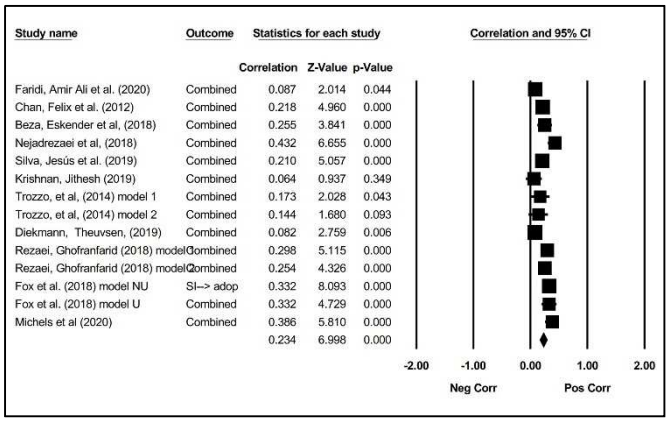

Fig. 5 Forest plot model from the journal

Fig. 6. encapsulates the forest plot from the construct of the UTAUT model. Behavioral intention (BI) variables were established from PE, EE, SI, and FC. Use Behavioral assembled from FC and BI factors. The relationship between PE and BI has a significant impact [36], [38]–[42], [45]. EE correlates BI [36], [37], [39]–[42], [45]. Alter in SI make BI transformed [38], [39], [41]–[43], [45]. FC factor can permute BI [39], [40], [42]. FC factors affect the Use Behavioral factor [36], [38], [39]. BI factors strengthen Use Behavioral in the journal [36], [38], [39]. There is a p-value of more than 0.05 for the EE factor, so BI's corresponding EE factor does not significantly affect it. Overall, the number of all correlations is 0,283 (p-value <0.01), with the most correlation (0.384) between BI and Use Behavioral. Heterogeneity value (I^2) for this forest plot was 70.3% (p-value <0.01), so it indicated moderate heterogeneity (greater than 50% and less than 75%).

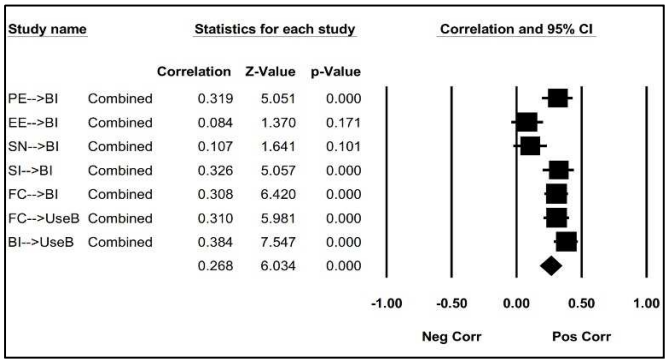

Fig. 6 Forest plot model for UTAUT factor from the journal

The UTAUT model is a technology acceptance model that operates more on psychological factors because it uses perceived rather than economic factors. The selected review came from economics; only 9% can exist. Socioeconomic factors are a popular theme in technological adoption in agriculture [14]. The model with the greatest correlation value in forest plots across models is the one with Use behavior established via BI and FC, followed by BI established through PE and SI [38]. This journal adheres to the UTAUT paradigm in its entirety. The creation of models may demonstrate that studying technology adoption does not necessarily need an increase in the number of variables; in 11 journals, 82 percent of research uses a modified UTAUT model, although the original model has a greater impact. The problem is that the Forest Plot heterogeneity is considerable, so interpreting the findings may be inaccurate. Heterogeneity may occur when there is a substantial difference in sample size across publications. The journal selection process used in this research affects the final findings. While narrowing the search terms may help minimize variability, limiting the number of journals collected.

In comparison between the Forest Plot of the factors in the UTAUT model, it is found that significant factors are BI, which is governed by PE (0.319), FC (0.308), SI (0.266). The Use of Behavioral predisposed by FC (0.310) and BI (0.384). These results can enlarge farmers' chance to use technology by exploring PE and FC factors, although the heterogeneity indicated moderate.

IV. Conclusion

Defer human food needs can be succeeded by increasing food sources. An alternative method to multiply food is by extending the number of farmers or producing farm technology. The decline in the number of farmers makes the option the approach can take by providing technology for farmers. For farmers to apply the technology, they need a technology adoption process. One of the adoption models is UTAUT. This study collects journals that aim to model adoption technology for a farmer using the UTAUT model. 11 journals converge the criteria. This study report BI (0,384) as the substantial factor that affects the Use Behavioral factor, while the lofty factor that affects BI is PE (0.319), FC (0.308). The use of technology in agriculture needs to be an expanse, introduced using the UTAUT model factor. In other words, Performance Expectancy, Social Influence, Facilitating Condition.

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