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Submitted Paper

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COVER LETTER FOR SUBMISSION OF NEW MANUSCRIPTS

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Subject: **SUBMISSION OF NEW MANUSCRIPT FOR EVALUATION**

I am enclosing herewith a manuscript entitled "**THE DEVELOPMENT OF INSTRUMENTS FOR FARMERS' PARTICIPATION IN WATER MANAGEMENT IN TIDAL LOWLANDS USING CONFIRMATORY FACTOR ANALYSIS**" submitted to "**Emirates Journal of Food and Agriculture**" for possible evaluation.

With the submission of this manuscript, I would like to undertake that the above-mentioned manuscript has not been published elsewhere, accepted for publication elsewhere or under editorial review for publication elsewhere; and that my Institute's **Universitas Swiwijaya** representative is fully aware of this submission.

Type of Submitted manuscript is Original Research Article.

For the Editor-in-Chief, I would like to disclose the following information about the project:

The research project was conducted under the supervision of:

- Muhammad Yazid
- Muh. Bambang Prayitno
- Muhamad Faizal
- F. X. Suryadi

and the project was run as my Ph.D. project

This research project was conducted from August 2019 to September 2019

My Research Project was partially or fully sponsored by Directorate General of Science and Technology Resources and the Directorate of Research and Community Service in the Ministry of

Research, Technology and Higher Education of Indonesia with grant number 068/SP2H/AMD/LT/DRPM/2020.

Details of each author with his/her contribution in this paper is as under:

Name of the author and e-mail ID	Types of contribution
Meitry Firdha Tafarini (meitrytafarini@student.pps.unsri.ac.id / meitrytafarini@gmail.com)	Wrote and translated the manuscript, collected theories, and built the model analysis
*Muhammad Yazid (yazid_ppmal@yahoo.com)	The corresponding author, he contrived this research, and contributed to the final manuscript as a supervisor
F. X. Suryadi (f.suryadi@un-ihe.org)	Discussed the results, corrected English spelling, and contributed to the final manuscript (as a 4th supervisor)
Muh. Bambang Prayitno (muhbambang_prayitno@yahoo.com)	Provided guide in collected data and corrected the content of the manuscript. Discussed the results and contributed to the final manuscript (as a 2nd supervisor)
Muhamad Faizal (mfaizal1405@gmail.com)	Provided guide in collected data and corrected the content of the manuscript. Discussed the results and contributed to the final manuscript (as a 3rd supervisor)
Khairul Fahmi Purba (khairulfahmi@student.pps.unsri.ac.id / fahmipurba09@gmail.com)	Assisted in data collection and data entry, also discussed the final manuscript

*Corresponding author

I would also like to share the following information with Editor-in-Chief

I have the following similar manuscripts already published from this project:

Tafarini, M. F., & Yazid, M. 2019. Sustainable water management in tidal lowland agriculture: a research agenda. Sriwijaya J. of Environ. 3(3): 102–107.

Tafarini, M. F., Yazid, M., Prayitno, M. B., Faizal, M., Suryadi, F. X., and Purba, K. F. 2021. Willingness to pay for water management to support sustainable food production in tidal lowlands of South Sumatra, Indonesia. Emir. J. Food Agric. 33: 1008–1017.

Purba, K. F., Yazid, M., Hasmeda, M., Adriani, D., & Tafarini, M. F. 2020. Technical efficiency and factors affecting rice production in tidal lowlands of south sumatra province Indonesia. Potravinarstvo Slovak J. of Food Sci. 14: 101–111.

Purba, K. F., Yazid, M., Hasmeda, M., Adriani, D., and Tafarini, M. F. 2021. The sustainability of rice farming practices in tidal swamplands of south sumatra indonesia. Potravinarstvo Slovak J. of Food Sci. 15: 9–17.

You are co-author of a submitted article

Dari: Emirates Journal of Food and Agriculture (noreply@ejmanager.com)

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Tanggal: Rabu, 30 Maret 2022 pukul 15.37 GMT+7

Dear Muhamad Yazid,

You are co-author in an article submitted to **Emirates Journal of Food and Agriculture** and entitled **The development of instruments for farmers' participation in water management in tidal lowlands using confirmatory factor analysis** (Manuscript Number: EJFA-2022-03-110).

Sending author: Muhamad Yazid (yazid_ppmal@yahoo.com)

If you think that you should not be one of the authors in this manuscript, please contact the editorial office (ejfa@uaeu.ac.ae). If you are a co-author for this paper, no further action is needed.

Thank you for submitting your work to our journal.

Best regards,

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Reviewed and Resubmit Paper

Dear Editorial Office
Emirates Journal of Food and Agriculture

Thank you for the comments of our article. We have been checked carefully the highlighted areas in the manuscript and made some corrections. Here are the responses for the reviewers' comments and other corrections:

Authors' Responses:

1: Introduction should be more focused on the previous works done on this topic

In the introduction has been added a paragraph that focus on the previous works and relate to the topic of this manuscript (line 60)

2: Please clearly mention the objectives

The objectives of the study mentioned in abstract line 18 and introduction line 71

3: Detailed methodology is not needed, instead, provide standard method references

The presented methodology in the manuscript is the standard method use for the data analysis used in this study.

4: Add photographs from the experiments

The research method is survey and interview to the farmers directly using questionnaires and, in this manuscript, has been added the photograph of the research location as Figure 1 in line 100.

5: Conclusion should be in a separate section

The conclusion had been written in a separate section (line 413).

6: Provide author contributions as separate section before reference

The authors' contributions had been written in a separate section before references (line 424).

7: References should be exactly as per the journal format, refer a recent article from the current issue in www.ejfa.me

The references has been corrected refer to the recent article from the current issue in www.ejfa.me as you can see in line 432.

Other corrections:

- Line 218 has been deleted and highlighted the sentences that mentioned the significant result of the analysis.
- Figure 1-6 has been revised to be figure 2-7 refer to the figure 1 has been added as a research location.

Notes:

Please make sure to view the manuscript with no mark up on the review toolbar to see the correct line of corrections according to the responses above.

The revised manuscript is attached. We are looking forward for the next step or responses of our article. Please let us know if there is anything else needed.

With Regards,

The development of instruments for farmers' participation in water management in tidal lowlands using confirmatory factor analysis

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ABSTRACT

Water user associations or farmer groups carry out water management on tidal land. In its management, the participation of farmers in the group is necessary. This study aimed to examine the indicators of participation that positively affect the sustainability of tidal agriculture. The variables used in this study are participation (5 indicators), leadership (5 indicators), attitude & understanding (4 indicators), and utilization & maintenance (4 indicators). The research locations were in the tidal area of Telang Karya and Telang Rejo Village. The number of samples in this study was 245 farmers. This study used confirmatory factor analysis (CFA) by building the model of first-order CFA and second-order CFA. Evaluation of the model was done by looking at the Goodness of Fit Indexes, namely chi-square ($\chi2$), root mean square error of approximation (RMSEA), CFI, TLI, GFI, and AGFI. The research results on the second-order CFA resulted in a value of R^2 = 137.414, and the model was a good fit. The results of the indicators analysis used were significant to be applied in tidal lowlands agriculture.

Keywords: tidal lowland, water management, participation, CFA

INTRODUCTION

Tidal lowland is a suboptimal land category that is widely used for agriculture. Tidal lowland is the reclamation of swampland that occurs between land and water. One of the largest tidal areas in Indonesia is in South Sumatra. The government had carried out the development of tidal areas in South Sumatra since 1969 through a transmigration program with an area of 2.92 million ha at the beginning of the reclamation (Euroconsult, 1995; Imanudin et al., 2010; Purba et al., 2020). The largest tidal area in South Sumatra is in Banyuasin Regency, with an area of 185964 ha in 2018 (Central Bureau of Statistics of Banyuasin Regency, 2019).

Tidal lowlands have four types of overflows based on the range of tides, i.e., types A, B, C, and D. This study focused on tidal lowlands type A where it is highly flooded constantly during either high or low tides (Fahri et al., 2021). Tidal lowland type A is very suitable for agricultural cultivation, especially food crops. In general, agriculture on tidal lands is highly dependent on tides over a certain period. However, this type-A topography makes it difficult to discharge water. This affects land washing from acidic properties, and the content of various toxic substances is not optimal (Armanto et al., 2013; Imanudin and Armanto, 2012; Tafarini and Yazid, 2019). So that proper water management is the primary key for thriving agriculture on tidal land.

Tidal lowland agriculture is very dependent on water, so in its management, the role of farmers both individually and in groups is crucial. In several locations, the water management system built by the government was carried out by the water user association (WUA) with the participatory irrigation management practices (Arun et al., 2012; Gomo et al., 2014; Perret, 2002). However, there were often recurring problems related to water management by farmers. These problems included high dependence on government support, weak institutions, lack of information on production strategies, and low water maintenance participation and management (Muchara et al., 2016). For success in sustainable tidal lowland farming, it is necessary to have proper planning, management, and utilization from land management, infrastructure technology, and especially aspects of water management. Furthermore, all these activities must be carried out in a participatory manner by the farmers.

This study assessed and confirmed the variables and indicators that form the site-specific farmers' participation model. The study goal was that these indicators could produce appropriate actions in sustainable water management (Bakri et al., 2020). If farmers can carry out water management in a participatory manner, it will reduce social conflicts and technical problems regarding the quality and quantity of agricultural water needs.

Scientific hypothesis

This study hypothesis is that latent variables of leadership, attitude and understanding, and utilization and maintenance have significant effect on latent variable of participation.

MATERIALS AND METHOD

Description of Study Site and Data Collection

This research was conducted in Muara Telang District, Banyuasin Regency, South Sumatra. Banyuasin Regency was formed from the division of Musi Banyuasin Regency with an area of 1,183,299 ha or 12.8% of the total area of South Sumatra. Banyuasin Regency consists of 21 districts, 16 sub-districts, and 288 villages (Central Bureau of Statistics of South Sumatra

Province, 2020). Sampling was carried out in Telang Karya and Telang Rejo Village. The data used were primary data obtained from direct interviews with farmer groups from the research locations. Interviews were conducted in August – September 2019 using structured questionnaires. The number of samples used in this study was 245 respondent farmers in those two research villages. Sampling used the purposive technique. Purposive sampling was carried out by considering that farmers are members of farmer groups who participate in water management and maintenance and water infrastructure, and farmers own tidal agricultural land in Telang Karya and Telang Rejo villages and not alternative land (PU land).

Data Analysis

Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) method was used to test the hypothesis in this study. CFA is an approach method used to test a set of variables/data whether it supports the hypothesized model (Knekta et al., 2019). CFA is based on previous measurements or theories in order to verify the factor structure of a series of observational variables (Hair et al., 2012; Mooi and Sarstedt, 2019). In this study, the CFA analysis was carried out in two stages, first order and second order confirmatory factor analysis.

First order CFA aims to determine the significant indicator of the latent variables. The covariance between the indicators in the first order CFA will be used in the second order CFA, which represents the nature and method of variance (Marsh and Hocevar, 1988). (Gould and Rutgers, 2015) revealed that second order CFA is a technique for interpreting scales as multilevel and multidimensional. This test was conducted to examine whether there is a relationship between latent participation (Y) and three sub-scales of latent X variables. The four latent variables were analyzed simultaneously. The relationship between First Order CFA and Second Order CFA is presented in the following equation (Rindskopf, 1984):

$$x = \lambda_x \xi + \delta \quad \textbf{(1)}$$

$$\eta = B\eta + \Gamma\xi + \zeta \quad \textbf{(2)}$$

$$x = \lambda_x \eta + \varepsilon \quad \textbf{(3)}$$

Where λ_x is matrix of loading factor (λ); B is loading coefficient; Γ and λ is loading factor first dan second order; ξ is vector for latent variables of size *nx1*; ζ is single variable vector (unique); x is vector for the indicator variables of size *px1*; δ is vector for measurement error of size *px1*; ε is vector for measurement error of size *nx1*.

Normality Multivariate Test

There were four latent variables used to measure farmers participation in water management. Each latent variable was measured by some indicators. Reaching the assumption should be done before conducting confirmatory factor analysis. This is purpose to test whether the data are multivariate normally distributed. The test was carried out with a multivariate χ^2 plot. The hypotheses used are as follows:

H_0: Normal multivariate distribution data.

H_1: The data are not normally distributed multivariate.

Statistical test:

$$d_j^2 = (X_i - \bar{X})\,'S^{-1}(X_i - \bar{X}) \quad \textbf{(4)}$$

The rejection region occurs if the value of $d_j^2 \leq \chi^2_{p;0.50}$ (Johnson and Wichern, 2007). In this study, the value of χ^2 = 137.414, reject H_0, so it can be concluded that all latent variables for measuring farmer participation in water management are normally distributed multivariate.

Model Identification

To identify the CFA model, both first order and second order, it is necessary to note that there are three identification categories (Hendry, 2009; Ramlall, 2017):

1. The under-identified shows that model analysis cannot be carried out.
2. Just identified shows that the former model cannot generalize, so the analysis cannot be carried out.

Over identified indicates that the degree of freedom is positive, so several levels of generalization can be made to obtain the most suitable model.

Goodness Of Fit (GOF) Criteria

After estimating, the CFA model was tested for model feasibility to determine the extent to which its specifications were consistent with the data. The evaluation process went through two aspects, i.e., the GOF of the overall model and the GOF of individual parameter estimation (Bentler, 1990). The model fit criteria include chi-square (χ^2), root mean square error of approximation (RMSEA), CFI, TLI, GFI, and AGFI. The suitability criteria were presented in the following Table 1:

Table 1 Goodness of Fit Index Criteria

Goodness of fit index	**Cut off value**	
χ^2 - Chi square	Expected small	(Hair et al., 2012, 2014)
Probability	≥ 0.05	
RMSEA	≤ 0.08	(Steiger, 1990)
CFI	≥ 0.90	(Hu L.-T. and Bentler P. M., 1999)

TLI	≥ 0.90	(Tucker and Lewis, 1973)
GFI	≥ 0.90	(Bentler, 1983; Joreskog and Sorbom, 1998)
AGFI	≥ 0.90	

A good model if the χ^2 test is not real at a certain level of significance. The hypothesis used is as follows:

H_0: The estimated population covariance is the same as the sample/model covariance according to the data

H_1: The estimated population covariance is not the same as the sample/model covariance does not match the data

The decision of the hypothesis rejects H_0 if $\chi^2 > \chi^2_{(\alpha = 5\%)}$ or p-value < 0.05. The model fits if it accepts H_0 or the model is in following the data.

Validity And Reliability Test

The measurement of a single construct was done by estimating the validity and construct reliability (CR). Validity is if an instrument can measure the model built, while reliability refers to the consistency of instrument measurement. Validity is indicated by the factor loading value of each indicator ≥ 0.5 dan p < 0.05 (Hair et al., 2009; Knekta et al., 2019). The factor loading value can be calculated using the following equation:

$$\lambda = (A^T - A)^{-1} A^T B \quad \textbf{(5)}$$

Where: λ = loading factor; A = indicator; B = latent

Furthermore, measured by estimating construct reliability. Referring to (Fornell and Larcker, 1981), the CR value was a measure of the consistent internal indicator of a variable. The following equation calculated the CR value:

$$CR = \frac{\left(\sum_{i=1}^{n} \lambda_i\right)^2}{\left(\sum_{i=1}^{n} \lambda_i\right)^2 + \left(\sum_{i=1}^{n} e_i\right)} \quad \textbf{(6)}$$

Where λ_i is factor loading for item i under a particular construct and e_i is the error variance for the item

A good indicator of reliability is if the CR value is 0.70 or more. However, the CR value in the range of 0.60 – 0.70 is still acceptable. While the value of CR < 0.60 indicates poor indicator reliability.

RESULTS

First order cfa on latent variable of participation

Latent variables of participation consist of five indicators.

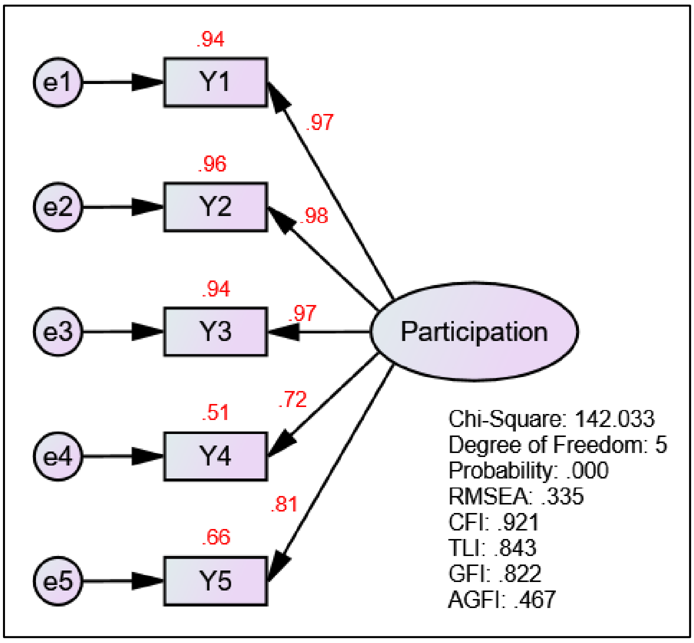

Figure 1 CFA Latent Variable of Participation

The value of degrees of freedom (df) = 5 indicates the model was over-identified. The analytical model was confirmed good if the GOF value was in accordance with the index criteria.

Table 2. Goodness of Fit Model CFA of Participation Latent Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	142.033	Expected small
Probability	≥ 0.05	0.000	Poor
RMSEA	≤ 0.08	0.335	Poor
CFI	≥ 0.90	0.921	Good fit
TLI	≥ 0.90	0.843	Poor
GFI	≥ 0.90	0.822	Good fit
AGFI	≥ 0.90	0.467	Poor

Table 2 indicate that the GOF value of the model was not suitable. Thus, it needs to be modified. Modification of the model was done by selecting the largest value of MI (Modification Indexes). The large MI values were the covariance of e2←→e4, e2←→e5, dan e4←→e5. The respective MI values in the covariance were 23.593; 23.798; and 92.132. Then the modified result has a degree of freedom value df = 2. This means that the model is over-identified, so the GOF value is presented in Table 3 below:

Table 3 Modification of Goodness of Fit Model CFA of Participation Latent Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	3.444	Expected small

Probability	≥ 0.05	0.179	Good fit
RMSEA	≤ 0.08	0.054	Good fit
CFI	≥ 0.90	0.999	Good fit
TLI	≥ 0.90	0.996	Good fit
GFI	≥ 0.90	0.994	Good fit
AGFI	≥ 0.90	0.958	Good fit

Based on the GOF values in Table 3, it can be concluded that the CFA model had conform the criteria. The overall model was fit. Furthermore, the loading factor value was tested to determine the magnitude of the indicator formation in forming the latent variable of participation. The indicator was significant if the p-value of the loading factor is less than $\alpha = 0.05$.

Table 4 Parameter Estimation CFA of Participation Latent Variable

Indicator	Loading Factor	Error Variance	R^2	P-Value	Resolve
Y1	0.967	0.074	0.935	0.000	Significant
Y2	**0.988**	0.028	**0.976**	0.000	Significant
Y3	0.965	0.084	0.931	0.000	Significant
Y4	0.727	0.768	0.528	0.000	Significant
Y5	0.827	0.459	0.683	0.000	Significant

Based on Table 4, all indicators significantly form the latent variable of farmer participation in water management. This was indicated by a p-value that was less than $\alpha = 0.05$. When observed from the loading factor value and R^2, the Y2 indicator (participating in cleaning the channels) was the most significant contribution, 97.6%. The next stage was the reliability test. The value of construct reliability was as follows:

$$CR = \frac{\left[\sum_{i=1}^{n} \lambda_i\right]^2}{\left[\sum_{i=1}^{n} \lambda_i\right]^2 + \left[\sum_{i}^{n} \delta_i\right]} = \frac{(4.474)^2}{(4.474)^2 + (1.413)} = 0.934 \qquad (7)$$

The construct reliability of the latent participation variable yields a value of 0.934. The value was more than 0.7 or 0.5, so the latent variable participation has high consistency or has good reliability.

First order cfa on latent variable of participation

The latent variable of leadership consists of 5 indicators**.**

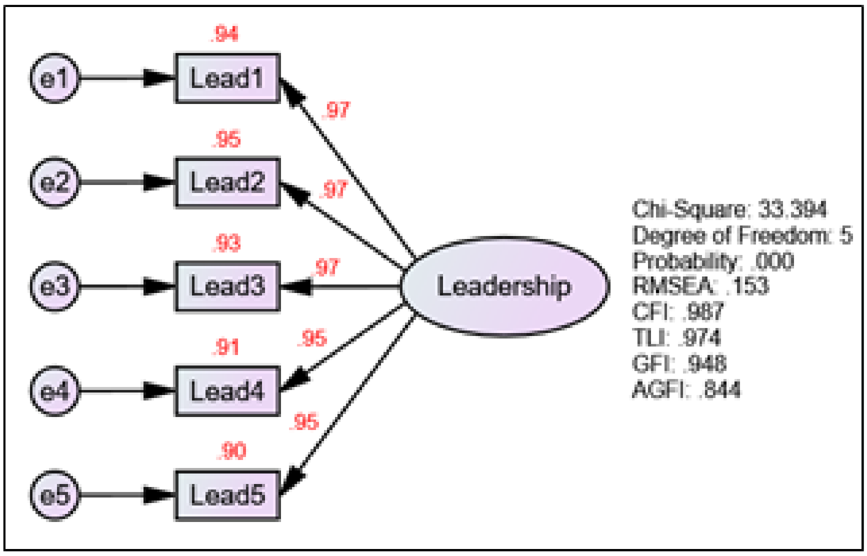

Figure 2 CFA of Leadership Latent Variable

Figure 2 was the estimation result of the leadership latent variable indicators. The df value = 5 explained that the model was over-identified.

Table 5 Goodness of Fit Model CFA of Leadership Latent Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	33.394	Expected small
Probability	≥ 0.05	0.000	Poor
RMSEA	≤ 0.08	0.153	Poor
CFI	≥ 0.90	0.987	Good fit
TLI	≥ 0.90	0.974	Good fit
GFI	≥ 0.90	0.948	Good fit
AGFI	≥ 0.90	0.844	Poor

Table 5 showed that the probability value was less than 0.05, and some GOF index criteria stated that the model was not fit. So, it can be concluded that the level of the model acceptance was not good. This meant that the model needed to be modified with the aim of a better model acceptance rate. The enormous MI value was 20.507; 10.077; and 4.627, which was the covariance of e3←→e4, e2←→e4, and e1←→e5. The result of the modification presented df = 2. This meant that the modified model was over-identified with the GOF criteria as follows:

Table 6 Goodness of Fit Modification Model CFA of Leadership Latent Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	2.013	Expected small
Probability	≥ 0.05	0.366	Good fit
RMSEA	≤ 0.08	0.005	Good fit
CFI	≥ 0.90	1.000	Good fit

TLI	≥ 0.90	1.000	Good fit
GFI	≥ 0.90	0.997	Good fit
AGFI	≥ 0.90	0.975	Good fit

Table 6 elaborated the modified GOF values to produce probability values, RMSEA, CFI, TLI, GFI, and AGFI had to fulfil the criteria. This meant that the overall model was acceptable, and the next step was reliability testing. The construct reliability value of the leadership variable was 0.978, so the latent variable of leadership had excellent reliability because the CR value was more than 0.7 or 0.5. The latent variable model of leadership had different contribution values before and after modification. It can be seen in Table 7.

Table 7 Contribution R^2 from Leadership Indicators Before dan After Modified

Indicator	**R^2 (before)**	**R^2 (after)**
Lead1	0.936	0.935
Lead2	**0.950**	**0.963**
Lead3	0.934	0.921
Lead4	0.910	0.907
Lead5	0.897	0.892

Table 7, the most significant contribution after modification was the Lead2 indicator (supporting each goal to be achieved) with a value of 0.963 or a contribution of 96.3%. The most significant contribution before and after modification did not differ from the R^2 value.

First Order CFA on Attitude and Understanding Latent Variables

Attitude and understanding latent variables consisted of 4 indicators.

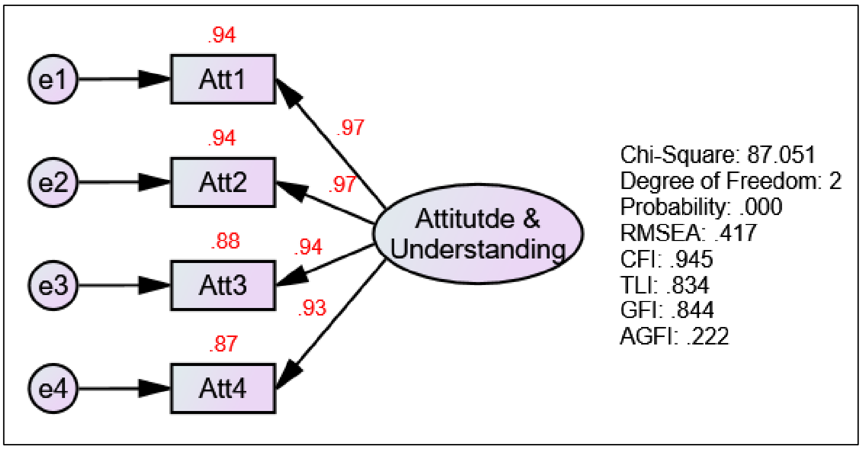

Figure 3 CFA Attitude and Understanding Latent Variables

Figure 3 was the estimation result of the attitude and understanding indicators of which consisted of 4 indicators. The df = 2 explained that the model was over-identified.

Table 8 Goodness of Fit Model CFA on Attitude and Understanding Latent Variables

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	87.051	Expected small
Probability	≥ 0.05	0.000	Poor
RMSEA	≤ 0.08	0.417	Good fit
CFI	≥ 0.90	0.945	Good fit
TLI	≥ 0.90	0.834	Poor
GFI	≥ 0.90	0.844	Poor
AGFI	≥ 0.90	0.222	Poor

In Table 8, the probability value was less than 0.05, so H_0 was rejected (the population covariance variance matrix was not the same as the estimated covariance of matrix variance). However, the Chi-square and probability values were very sensitive to the number of samples, so another suitability test was needed. The suitable GOF values with the criteria were RMSEA and CFI values, while the others did not fit the criteria. This meant that the overall model was unacceptable and needed to be modified by choosing the largest MI value. The largest MI value is 73.114, which was the covariance of e3←→e4. After being modified, the value of df became 1. It meant the model was over-identified.

Table 9 Goodness of Fit Modification Model CFA of Attitude and Understanding Latent Variables

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	0.236	Expected small
Probability	≥ 0.05	0.627	Good fit
RMSEA	≤ 0.08	0.000	Good fit
CFI	≥ 0.90	1.000	Good fit
TLI	≥ 0.90	1.000	Good fit
GFI	≥ 0.90	1.000	Good fit
AGFI	≥ 0.90	0.995	Good fit

Table 9 explained the modified GOF value to produce a better value according to the criteria. The overall model was a good fit and can be continued to the next step. The reliability test was calculated with the construct reliability (CR) value. The CR value for the latent variable attitude and understanding was 0.961. This value was more than 0.7 or 0.5. This meant that the attitude and understanding variables had high consistency.

Table 10 R^2 Contribution in Attitude and Understanding Indicators Before and After Modification

Indicators	Loading Factor	R^2	Loading Factor	R^2
	Before		After	
Att1	0.968	0.938	0.975	0.950
Att2	**0.970**	**0.941**	**0.977**	**0.955**
Att3	0.939	0.882	0.919	0.845
Att4	0.932	0.869	0.911	0.830

Table 10 showed the indicators with the most significant loading factor and R^2 values. After being modified, the indicator Att2 (responding, giving answers, working on, and completing the assigned task) gave the largest contribution to the attitude and understanding variable with a percentage of 95.5%.

First Order CFA on Utilization and Operation (Util) of Maintenance Latent Variables

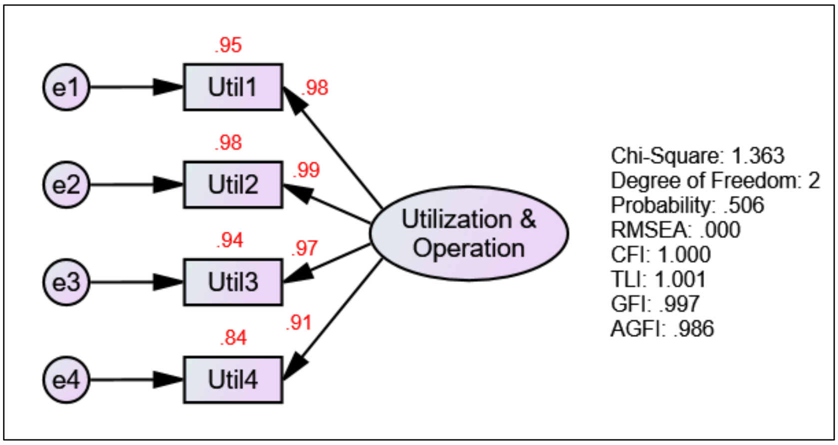

Figure 4 CFA Latent Variables of Utilization and Operation

Table 11 Goodness of Fit Utilization and Operation Latent Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	1.363	Expected small
Probability	≥ 0.05	0.506	Good fit
RMSEA	≤ 0.08	0.000	Good fit
CFI	≥ 0.90	1.000	Good fit
TLI	≥ 0.90	1.001	Good fit
GFI	≥ 0.90	0.997	Good fit
AGFI	≥ 0.90	0.986	Good fit

Table 11, the probability value was 0.05. This meant accepting H_0, so the population of covariance variance matrix was the same as the estimated covariance variance matrix. In addition, other conformity tests such as CFI, TLI, GFI, and AGFI had good fit criteria of 0.90 and RMSEA value = 0.000 or less than 0.08. Therefore, the overall model was a good fit and did not need modification. The next step was to calculate the CR value to see the reliability of the latent variable.

Table 12 Parameter Estimation of CFA Latent Variable of Utilization and Operation

Indicator	Loading Factor	Error Variance	R^2	P-Value	Resolve
Util1	0.977	0.046	0.954	0.000	Significant
Util2	**0.990**	0.018	**0.981**	0.000	Significant
Util3	0.968	0.061	0.937	0.000	Significant
Util4	0.915	0.164	0.954	0.000	Significant

In latent UO, all indicators were significant. This showed that these indicators could explain the presence of latent UO. The Util2 indicator (utilization and operation of infrastructure at the planting phase) was an indicator that gave the largest contribution in explaining the latent UO because it had a loading factor value of 0.990 and $R^2 = 0.981$ (the largest) with the minor error of 0.018. The value of construct reliability can be obtained by using the formula 8 as follows:

$$CR = \frac{[\sum_{i=1}^{n} \lambda_i]^2}{[\sum_{i=1}^{n} \lambda_i]^2 + [\sum_{i}^{n} \delta_i]} = \frac{(3.850)^2}{(3.850)^2 + (0.289)} = 0.981 \qquad \textbf{(8)}$$

The CR value of the latent variable UO was 0.981. This value was greater than 0.7 or 0.5. This meant that the latent variables of utilization and operation had good reliability.

Second Order Confirmatory Latent Variable of Participation

The second-order CFA for the participation variable consisted of 3 indicators, i.e., leadership, attitude & understanding, and utilization & operation.

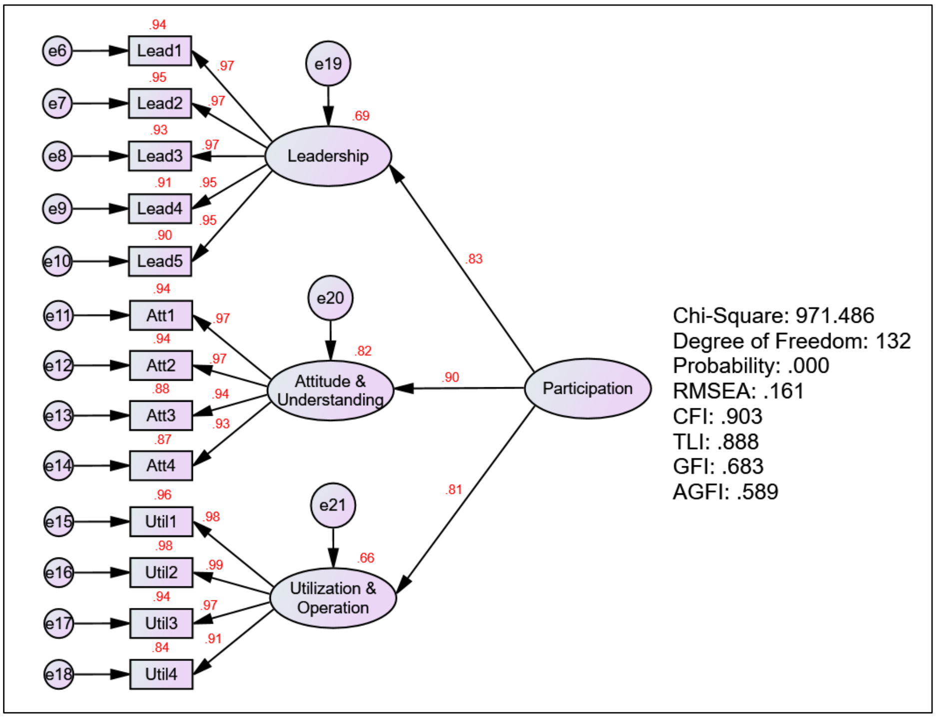

Figure 5 Second Order CFA

Figure 5 is the standardized estimation value of the second-order CFA farmers' participation in water management. The test results showed the value of df = 132, which indicated the over-identified model. Then the evaluation stage could be carried out for the suitability of the model.

Table 13 Goodness of Fit Second Order Participation Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	971.486	Expected small
Probability	≥ 0.05	0.000	Poor
RMSEA	≤ 0.08	0.161	Poor
CFI	≥ 0.90	0.903	Good fit
TLI	≥ 0.90	0.888	Poor
GFI	≥ 0.90	0.683	Poor
AGFI	≥ 0.90	0.589	Poor

Table 13 showed only the value of CFI = 0.903 (≥ 0.90) that suited the criteria, while the other criteria were not. Therefore, the overall model was not good (not fit). Therefore, the initial model needed modification. Modification of the model was done by selecting the largest MI value, which was presented in the following table:

Table 14 Modification Indexes Value

Covariances	M.I.	Covariances	M.I.
e19 ←→ e20	88.850	e5 ←→ e19	44.563
e17 ←→ e21	8.585	e5 ←→ e16	6.025

e16	←→	e19	4.256	e5	←→	e11	9.006
e14	←→	e15	5.299	e4	←→	e20	76.824
e13	←→	e20	13.632	e4	←→	e19	8.665
e13	←→	e19	18.307	e4	←→	e13	10.385
e12	←→	e19	7.466	e3	←→	e16	35.569
e11	←→	e19	6.537	e3	←→	e14	14.544
e11	←→	e17	20.338	e3	←→	e11	12.856
e10	←→	e20	19.456	e3	←→	e10	11.877
e9	←→	e12	12.654	e3	←→	e8	22.261
e9	←→	e11	19.912	e2	←→	e16	17.931
e8	←→	e11	15.195	e2	←→	e14	11.708
e8	←→	e9	20.847	e2	←→	e5	39.743
e7	←→	e14	8.901	e2	←→	e4	40.112
e5	←→	e21	21.492	e1	←→	e5	6.545
e5	←→	e20	93.103	e1	←→	e2	30.306

Table 14 is the value of M.I. selected for the modification of the participation second-order model. The following figure 6 presents the results of the model modification.

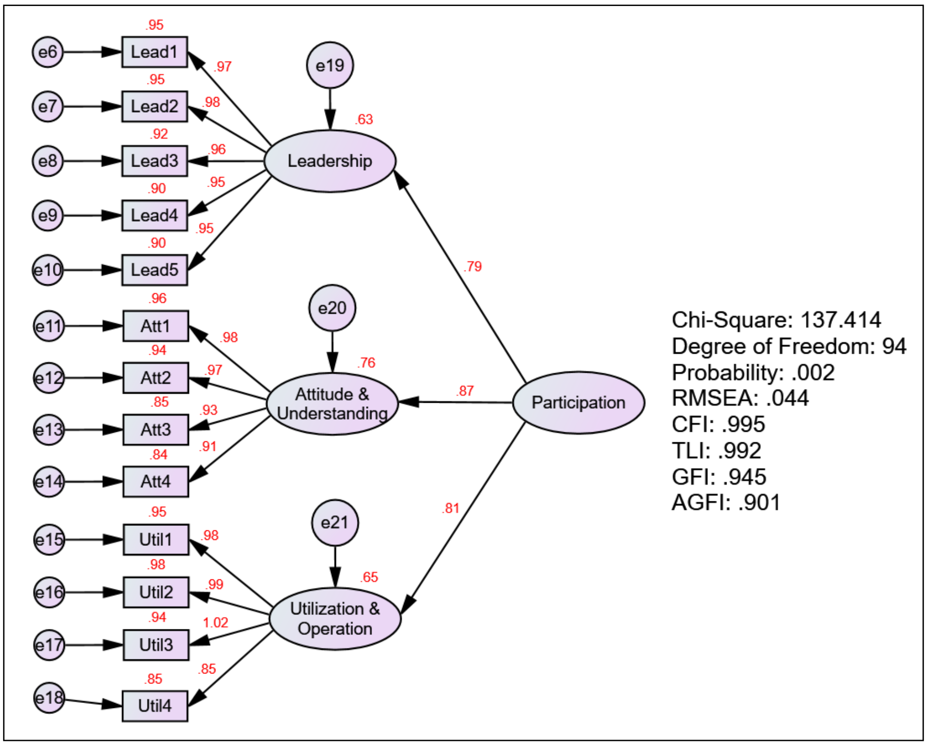

Figure 6 The Modification of Second-Order Participation Variable

In Figure 6, the df = 94 meant that the model was over-identified. The results of the feasibility test of the modified model were presented in Table 15 below:

Table 15 The Modification Goodness of Fit of Second-Order Participation Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	137.414	Expected small
Probability	≥ 0.05	0.002	Poor
RMSEA	≤ 0.08	0.044	Good fit
CFI	≥ 0.90	0.995	Good fit
TLI	≥ 0.90	0.992	Good fit
GFI	≥ 0.90	0.945	Good fit

AGFI	≥ 0.90	0.901	Good fit

Table 15 was the GOF result of the modified model. Even though the probability value was less than 0.05 (reject H_0: the estimated population covariance was not the same as the sample/model covariance did not match the data), but other criteria such as RMSEA, CFI, TLI, GFI, and AGFI was suitable so that the model can be accepted. In the reliability test, the value of the second-order reliability construct of participation was 0.989. The CR value was more than 0.7 or 0.5 (high reliability), so there was high consistency in measuring the latent construct. After being modified in the value of R^2 and loading factor, the most significant contribution indicator was Util2 (utilization and operation of infrastructure at the planting phase). The contribution of the Util2 indicator made up the latent variable of participation, 98.2%.

DISCUSSIONS

Participation is a collaborative decision-making process hoping that it will affect decision-makers (Becker and Gerhart, 1996; Brager et al., 1987). Leader involvement is a form of participation to determine a goal. Leadership is an attitude that every group leader must-have. Therefore, the role of the leader is significant in decision-making (Margerison and Glube, 1979). In addition, other group members will be involved when participation is applied in planning. This is done to structure steps and make decisions regarding the objectives of group operations.

In this study, leadership was one of the variables that determine the attitudes and understanding of each member in participating. Attitude was an important study subject used to predict social behavior (Petty et al., 1997). Several studies had shown a relationship between attitudes and participation. Research Bagherian et al., (2011), stated that farmers who had a negative attitude towards government regulations regarding wetlands were less likely to want to participate in water management. His research in Iran resulted in the finding that the attitude variable was essential for participation in the program and understanding the participation behavior of certain groups. If the farmer had a positive attitude, this could support in achieving the group's program goals. Farmers who have a good attitude and understanding of water resources tend to want to participate in its management. In the group, the attitude of responding, giving answers, working on, and completing the assigned tasks would positively influence participatory management (Davidescu et al., 2020; Saiz-Rubio and Rovira-Más, 2020).

Tidal lowland agriculture, which is highly dependent on water, requires wise use. Farmers not only take advantage of water resources but also have to manage them properly. Water management on tidal land at the research site was assisted by water infrastructure such as water channels equipped with sluice gates. This floodgate functions to hold water in the canal when needed and disposed of water when it is excessive. In addition, these water-gates and channels also function to wash the land from acidity and remove chemical residues on the land (Imanudin et al., 2010; Sulaiman et al., 2019). In Tafarini et al. (2021) research, the management of this infrastructure requires costs. Not only management but maintenance also requires costs to support efficient utilization. In its utilization, farmers must be equipped with an understanding of the tidal irrigation system and the use of water infrastructure. MacDonald (2019) research, stated that the operation and maintenance of water infrastructure were carried out in a participatory manner by the water user association group. Water infrastructure maintenance was carried out regularly so that it can be utilized optimally for the sustainability of water management in tidal areas (Regulation of the Minister of Public Works and Public Housing, 2015; Saiz-Rubio & Rovira-Más, 2020; Tafarini & Yazid, 2019). Therefore, the variables of leadership, attitude & understanding, and utilization & maintenance are closely related to farmer participation in water management.

Based on the confirmatory factor analysis results, it was confirmed that participation was formed if the variables of leadership, attitude & understanding, and utilization & maintenance were the benchmarks for the success of tidal water management. The specification of indicators for each variable was an indicator in water management in tidal agriculture. The success and sustainability of water management encourage sustainable agriculture. In Pretty (1995) research, the success of sustainable agriculture must be supported by the group's participation responsible for its management. Leadership was an essential factor in decision-making. A leadership attitude needs to be possessed by a leader and its members to play an active role in carrying out their duties (Ejimabo, 2015). Research of Al-Rawahi & Al-Yaaribi (2013), stated that a person's attitudes and understanding influence various aspects of group participation.

CONCLUSION

Questionnaire data that had been collected accurately measured four latent variables and 18 constituent indicators. The constituent indicators of the latent variables of participation, leadership, attitude & understanding, and utilization & operation had a significant p-value, indicating that all loading factor values had a significant (unidimensional) effect on the latent variables in first-order confirmatory factor analysis (CFA). However, there were some estimated that required modification to get a good measurement model. Therefore, the value of the contribution of latent variables and indicators varies. The most critical indicators that make up the latent variables of participation in the second-order contribution are Util2. Indicator Util2 is the utilization and operation of water infrastructure used at the planting stage.

AUTHORS' CONTRIBUTIONS

Meitry Firdha Tafarini wrote and translated the manuscript, collected theories, and built the model analysis. Muhammad Yazid was the corresponding author, and he contrived this research. Muh Bambang Prayitno and Muhammad Faizal provided guide in collected data and corrected the content of the manuscript. F.X. Suryadi corrected the English and typewriting. Khairul Fahmi Purba assisted in data collection and data entry. All authors discussed the result and contributed to the final manuscript.

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Conflict of Interest:

The authors declare no conflict of interest.

Ethical Statement:

This article does not contain any studies that would require an ethical statement.

Acceptance Letter

(13 Januari 2022)

January 13, 2022

Dear Meitry Firdha Tafarini

I am pleased to inform you that your manuscript titled as "Willingness to pay for water management to support sustainable food production in tidal lowlands of South Sumatra, Indonesia" (Manuscript Number: EJFA-2021-10-434 was accepted for publication in the Emirates Journal of Food and Agriculture.
As we declared in "Instructions for Authors", you need to contribute to Emirates Journal of Food and Agriculture for Publication Fee (APC).

For this purpose you should pay the following amount: 1000 AED .

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RESEARCH ARTICLE

The development of instruments for farmers' participation in water management in tidal lowlands using confirmatory factor analysis

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ABSTRACT

Water user associations or farmer groups carry out water management on tidal land. In its management, the participation of farmers in the group is necessary. This study aimed to examine the indicators of participation that positively affect the sustainability of tidal agriculture. The variables used in this study are participation (5 indicators), leadership (5 indicators), attitude & understanding (4 indicators), and utilization & maintenance (4 indicators). The research locations were in the tidal area of Telang Karya and Telang Rejo Village. The number of samples in this study was 245 farmers. This study used confirmatory factor analysis (CFA) by building the model of first-order CFA and second-order CFA. Evaluation of the model was done by looking at the Goodness of Fit Indexes, namely chi-square ($\chi2$), root mean square error of approximation (RMSEA), CFI, TLI, GFI, and AGFI. The research results on the second-order CFA resulted in a value of R^2 = 137.414, and the model was a good fit. The results of the indicators analysis used were significant to be applied in tidal lowlands agriculture.

Keywords: tidal lowland, water management, participation, CFA

INTRODUCTION

Tidal lowland is a suboptimal land category that is widely used for agriculture. Tidal lowland is the reclamation of swampland that occurs between land and water. One of the largest tidal areas in Indonesia is in South Sumatra. The government had carried out the development of tidal areas in South Sumatra since 1969 through a transmigration program with an area of 2.92 million ha at the beginning of the reclamation (Euroconsult, 1995; Imanudin et al., 2010; Purba et al., 2020). The largest tidal area in South Sumatra is in Banyuasin Regency, with an area of 185964 ha in 2018 (Central Bureau of Statistics of Banyuasin Regency, 2019).

Tidal lowlands have four types of overflows based on the range of tides, i.e., types A, B, C, and D. This study focused on tidal lowlands type A where it is highly flooded constantly during either high or low tides (Fahri et al., 2021). Tidal lowland type A is very suitable for agricultural cultivation, especially food crops. In general, agriculture on tidal lands is highly dependent on tides over a certain period. However, this type-A topography makes it difficult to discharge water. This affects land washing from acidic properties, and the content of various toxic substances is not optimal (Armanto et al., 2013; Imanudin and Armanto, 2012; Tafarini and Yazid, 2019). So that proper water management is the primary key for thriving agriculture on tidal land.

Tidal lowland agriculture is very dependent on water, so in its management, the role of farmers both individually and in groups is crucial. In several locations, the water management system built by the government was carried out by the water user association (WUA) with the participatory irrigation

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management practices (Arun et al., 2012; Gomo et al., 2014; Perret, 2002). However, there were often recurring problems related to water management by farmers. These problems included high dependence on government support, weak institutions, lack of information on production strategies, and low water maintenance participation and management (Muchara et al., 2016). For success in sustainable tidal lowland farming, it is necessary to have proper planning, management, and utilization from land management, infrastructure technology, and especially aspects of water management. Furthermore, all these activities must be carried out in a participatory manner by the farmers.

Tidal lowlands are highly dependent on seasonal patterns, so it is important to maintain the quantity or availability of water with proper management (Ar-Riza and Alkasuma, 2008). Proper water management is carried out by controlling water structures such as water gates by farmers individually or in groups. The arrangement of water gates must be carried out in a participatory manner, so water distribution to the land is carried out properly and at the right time. Ibrahim et al., (2017) research stated the concept of measuring participation variables in operation and maintenance, namely the characteristics of respondents (name, gender, age, and level of education). Yenifa et al., (2013) research stated that increasing participation in irrigation management could have a positive impact on agricultural products. This means that proper water management with the participation of water users (farmers) could have a positive effect on agricultural development and sustainability.

This study objectives were to assessed and confirmed the variables and indicators that form the site-specific farmers' participation model. The study goal was that these indicators could produce appropriate actions in sustainable water management. If farmers can carry out water management in a participatory manner, it will reduce social conflicts and technical problems regarding the quality and quantity of agricultural water needs (Bakri et al., 2020).

Scientific hypothesis

This study hypothesis is that latent variables of leadership, attitude and understanding, and utilization and maintenance have significant effect on latent variable of participation.

MATERIALS AND METHOD

Description of study site and data collection

This research was conducted in Muara Telang District, Banyuasin Regency, South Sumatra. Banyuasin Regency was formed from the division of Musi Banyuasin Regency with an area of 1,183,299 ha or 12.8% of the total area of South Sumatra. Banyuasin Regency consists of 21 districts, 16 sub-districts, and 288 villages (Central Bureau of Statistics of South Sumatra Province, 2020). Sampling was carried out in Telang Karya and Telang Rejo Village. The data used were primary data obtained from direct interviews with farmer groups from the research locations. Interviews were conducted in August – September 2019 using structured questionnaires. The number of samples used in this study was 245 respondent farmers in those two research villages. Sampling used the purposive technique. Purposive sampling was carried out by considering that farmers are members of farmer groups who participate in water management and maintenance and water infrastructure, and farmers own tidal agricultural land in Telang Karya and Telang Rejo villages and not alternative land (PU land).

Data Analysis

Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) method was used to test the hypothesis in this study. CFA is an approach method used to test a set of variables/data whether it supports the hypothesized model (Knekta et al., 2019). CFA is based on previous measurements or theories in order to verify the factor structure of a series of observational variables (Hair et al., 2012; Mooi and Sarstedt, 2019). In this study, the CFA analysis was carried out in two stages, first order and second order confirmatory factor analysis.

First order CFA aims to determine the significant indicator of the latent variables. The covariance between the indicators in the first order CFA will be used in the second order CFA, which represents the nature and method of variance (Marsh and Hocevar, 1988). Gould and Rutgers, 2015 revealed that second order CFA is a technique for interpreting scales as multilevel and multidimensional. This test was conducted to examine whether there is a relationship between latent participation (Y) and three sub-scales of latent X variables. The four latent variables were analyzed simultaneously. The relationship between First Order CFA and Second Order CFA is presented in the following equation (Rindskopf, 1984):

$$x = \lambda_x \xi + \delta \quad (1)$$

$$\eta = B\eta + \Gamma\xi + \zeta \quad (2)$$

$$x = \lambda_x \eta + \varepsilon \quad (3)$$

Where λ_x is matrix of loading factor (λ); B is loading coefficient; Γ and λ is loading factor first dan second order; ξ is vector for latent variables of size *nx1*; ζ is single variable vector (unique); x is vector for the indicator variables of size *px1*; δ is vector for measurement error of size *px1*; ε is vector for measurement error of size *nx1*.

Normality multivariate test

There were four latent variables used to measure farmers participation in water management. Each latent variable was measured by some indicators. Reaching the assumption should be done before conducting confirmatory factor analysis. This is purpose to test whether the data are multivariate normally distributed. The test was carried out with a multivariate χ^2 plot. The hypotheses used are as follows:

H_0: Normal multivariate distribution data.

H_1: The data are not normally distributed multivariate.

Statistical test:

$$d_j^2 = (X_i - \bar{X})' S^{-1} (X_i - \bar{X}) \quad (4)$$

The rejection region occurs if the value of $d_j^2 \leq \chi^2_{p;0.50}$ (Johnson and Wichern, 2007). In this study, the value of $\chi^2 = 137.414$, reject H_0, so it can be concluded that all latent variables for measuring farmer participation in water management are normally distributed multivariate.

Model identification

To identify the CFA model, both first order and second order, it is necessary to note that there are three identification categories (Hendry, 2009; Ramlall, 2017):

1. The under-identified shows that model analysis cannot be carried out.
2. Just identified shows that the former model cannot generalize, so the analysis cannot be carried out.

Over identified indicates that the degree of freedom is positive, so several levels of generalization can be made to obtain the most suitable model.

Goodness of fit (GOF) criteria

After estimating, the CFA model was tested for model feasibility to determine the extent to which its specifications were consistent with the data. The evaluation process went through two aspects, i.e., the GOF of the overall model and the GOF of individual parameter estimation (Bentler, 1990). The model fit criteria include chi-square (χ^2), root mean square error of approximation (RMSEA), CFI, TLI, GFI, and AGFI. The suitability criteria were presented in the following Table 1:

A good model if the χ^2 test is not real at a certain level of significance. The hypothesis used is as follows:

H_0: The estimated population covariance is the same as the sample/model covariance according to the data

H_1: The estimated population covariance is not the same as the sample/model covariance does not match the data

Table 1: Goodness of Fit Index Criteria

Goodness of fit index	Cut off value	
χ^2 - Chi square	Expected small	(Hair et al., 2012, 2014)
Probability	≥ 0.05	
RMSEA	≤ 0.08	(Steiger, 1990)
CFI	≥ 0.90	(Hu L.-T. and Bentler P. M., 1999)
TLI	≥ 0.90	(Tucker and Lewis, 1973)
GFI	≥ 0.90	(Bentler, 1983; Joreskog and Sorbom, 1998)
AGFI	≥ 0.90	

The decision of the hypothesis rejects H_0 if $\chi^2 > \chi^2_{(\alpha = 5\%)}$ or p-value < 0.05. The model fits if it accepts H_0 or the model is in following the data.

Validity And Reliability Test

The measurement of a single construct was done by estimating the validity and construct reliability (CR). Validity is if an instrument can measure the model built, while reliability refers to the consistency of instrument measurement. Validity is indicated by the factor loading value of each indicator ≥ 0.5 dan p < 0.05 (Hair et al., 2009; Knekta et al., 2019). The factor loading value can be calculated using the following equation:

$$\lambda = (A^T - A)^{-1} A^T B \quad (5)$$

Where: λ = loading factor; A = indicator; B = latent

Furthermore, measured by estimating construct reliability. Referring to (Fornell and Larcker, 1981), the CR value was a measure of the consistent internal indicator of a variable. The following equation calculated the CR value:

$$CR = \frac{\left(\sum_{i=1}^{n} \lambda_i\right)^2}{\left(\sum_{i=1}^{n} \lambda_i\right)^2 + \left(\sum_{i=1}^{n} e_i\right)} \quad (6)$$

Where λ_i is factor loading for item i under a particular construct and e_i is the error variance for the item

A good indicator of reliability is if the CR value is 0.70 or more. However, the CR value in the range of 0.60 – 0.70 is still acceptable. While the value of CR < 0.60 indicates poor indicator reliability.

RESULTS

First order cfa on latent variable of participation

Latent variables of participation consist of five indicators.

The value of degrees of freedom (df) = 5 indicates the model was over-identified. The analytical model was confirmed good if the GOF value was in accordance with the index criteria.

Table 2 indicate that the GOF value of the model was not suitable. Thus, it needs to be modified. Modification of the model was done by selecting the largest value of MI (Modification Indexes). The large MI values were the covariance of e2←→e4, e2←→e5, dan e4←→e5. The respective MI values in the covariance were 23.593; 23.798; and 92.132. Then the modified result has a degree of freedom value df = 2. This means that the model is over-identified, so the GOF value is presented in Table 3 below:

Based on the GOF values in Table 3, it can be concluded that the CFA model had conform the criteria. The overall model was fit. Furthermore, the loading factor value was tested to determine the magnitude of the indicator formation in forming the latent variable of participation. The indicator was significant if the p-value of the loading factor is less than $\alpha = 0.05$.

Based on Table 4, all indicators significantly form the latent variable of farmer participation in water management. This was indicated by a p-value that was less than $\alpha = 0.05$. The Y2 indicator (participating in cleaning the channels) was the most significant contribution. It had the loading factor value of 0.988 and R^2 of 97.6%. It meant that the Y2 had the highest significant effect to the participation. The next stage was the reliability test. The value of construct reliability was as follows:

$$CR = \frac{\left[\sum_{i=1}^{n}\lambda_i\right]^2}{\left[\sum_{i=1}^{n}\lambda_i\right]^2 + \left[\sum_{i}^{n}\delta_i\right]} = \frac{(4.474)^2}{(4.474)^2 + (1.413)} = 0.934 \quad (7)$$

The construct reliability of the latent participation variable yields a value of 0.934. The value was more than 0.7 or 0.5, so the latent variable participation has high consistency or has good reliability.

Table 2: Goodness of Fit Model CFA of Participation Latent Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	142.033	Expected small
Probability	≥ 0.05	0.000	Poor
RMSEA	≤ 0.08	0.335	Poor
CFI	≥ 0.90	0.921	Good fit
TLI	≥ 0.90	0.843	Poor
GFI	≥ 0.90	0.822	Good fit
AGFI	≥ 0.90	0.467	Poor

First order cfa on latent variable of participation

The latent variable of leadership consists of 5 indicators**.**

Fig. 2 was the estimation result of the leadership latent variable indicators. The df value = 5 explained that the model was over-identified.

Table 5 showed that the probability value was less than 0.05, and some GOF index criteria stated that the model was not fit. So, it can be concluded that the level of the model acceptance was not good. This meant that the model needed to be modified with the aim of a better model acceptance rate. The enormous MI value was 20.507; 10.077; and 4.627, which was the covariance of e3←→e4, e2←→e4, and e1←→e5. The result of the modification presented df = 2. This meant that the modified model was over-identified with the GOF criteria as follows:

Table 6 elaborated the modified GOF values to produce probability values, RMSEA, CFI, TLI, GFI, and AGFI had to fulfil the criteria. This meant that the overall model was

Table 3: Modification of Goodness of Fit Model CFA of Participation Latent Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	3.444	Expected small
Probability	≥ 0.05	0.179	Good fit
RMSEA	≤ 0.08	0.054	Good fit
CFI	≥ 0.90	0.999	Good fit
TLI	≥ 0.90	0.996	Good fit
GFI	≥ 0.90	0.994	Good fit
AGFI	≥ 0.90	0.958	Good fit

Table 4: Parameter Estimation CFA of Participation Latent Variable

Indicator	Loading Factor	Error Variance	R^2	P-Value	Resolve
Y1	0.967	0.074	0.935	0.000	Significant
Y2	0.988	0.028	0.976	0.000	Significant
Y3	0.965	0.084	0.931	0.000	Significant
Y4	0.727	0.768	0.528	0.000	Significant
Y5	0.827	0.459	0.683	0.000	Significant

Table 5: Goodness of Fit Model CFA of Leadership Latent Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	33.394	Expected small
Probability	≥ 0.05	0.000	Poor
RMSEA	≤ 0.08	0.153	Poor
CFI	≥ 0.90	0.987	Good fit
TLI	≥ 0.90	0.974	Good fit
GFI	≥ 0.90	0.948	Good fit
AGFI	≥ 0.90	0.844	Poor

Fig 1. Research Location.

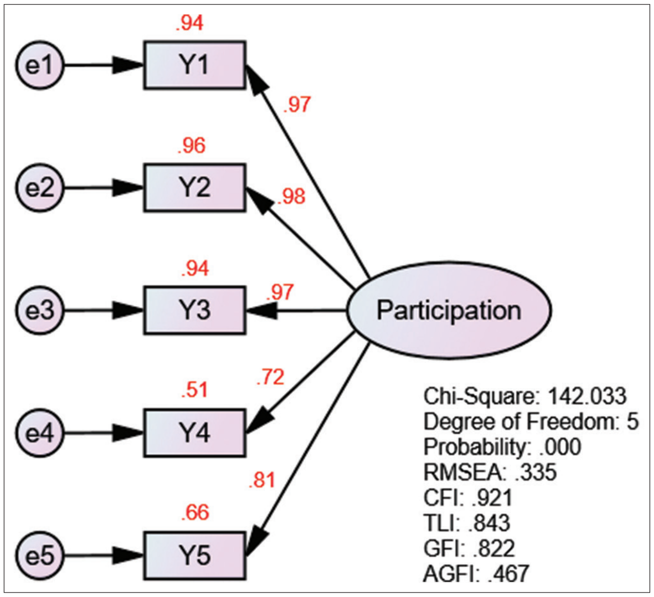

Fig 2. CFA Latent Variable of Participation.

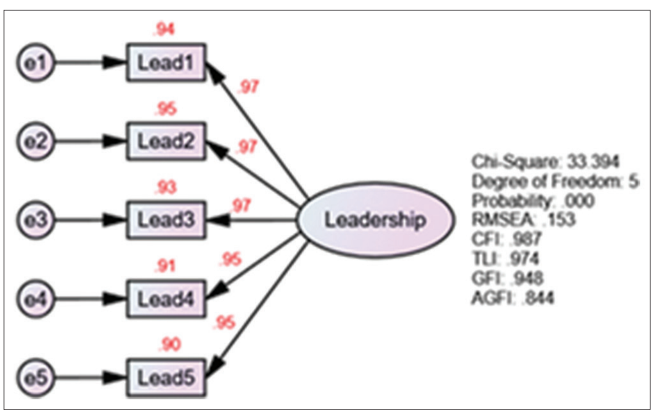

Fig 3. CFA of Leadership Latent Variable

acceptable, and the next step was reliability testing. The construct reliability value of the leadership variable was 0.978, so the latent variable of leadership had excellent reliability because the CR value was more than 0.7 or 0.5. The latent variable model of leadership had different contribution values before and after modification. It can be seen in Table 7.

Table 7, the most significant contribution after modification was the Lead2 indicator (supporting each goal to be achieved) with a value of 0.963 or a contribution of 96.3%. The most significant contribution before and after modification did not differ from the R^2 value.

Table 6: Goodness of Fit Modification Model CFA of Leadership Latent Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	2.013	Expected small
Probability	≥ 0.05	0.366	Good fit
RMSEA	≤ 0.08	0.005	Good fit
CFI	≥ 0.90	1.000	Good fit
TLI	≥ 0.90	1.000	Good fit
GFI	≥ 0.90	0.997	Good fit
AGFI	≥ 0.90	0.975	Good fit

Table 7: Contribution R^2 from Leadership Indicators Before dan After Modified

Indicator	R^2 (before)	R^2 (after)
Lead1	0.936	0.935
Lead2	0.950	0.963
Lead3	0.934	0.921
Lead4	0.910	0.907
Lead5	0.897	0.892

First Order CFA on Attitude and Understanding Latent Variables

Attitude and understanding latent variables consisted of 4 indicators.

Fig. 3 was the estimation result of the attitude and understanding indicators of which consisted of 4 indicators. The df = 2 explained that the model was over-identified.

In Table 8, the probability value was less than 0.05, so H_0 was rejected (the population covariance variance matrix was not the same as the estimated covariance of matrix variance). However, the Chi-square and probability values were very sensitive to the number of samples, so another suitability test was needed. The suitable GOF values with the criteria were RMSEA and CFI values, while the others did not fit the criteria. This meant that the overall model was unacceptable and needed to be modified by choosing the largest MI value. The largest MI value is 73.114, which was the covariance of e3←→e4. After being modified, the value of df became 1. It meant the model was over-identified.

Table 9 explained the modified GOF value to produce a better value according to the criteria. The overall model was a good fit and can be continued to the next step. The reliability test was calculated with the construct reliability (CR) value. The CR value for the latent variable attitude and understanding was 0.961. This value was more than 0.7 or 0.5. This meant that the attitude and understanding variables had high consistency.

Table 10 showed the indicators with the most significant loading factor and R^2 values. After being modified, the indicator Att2 (responding, giving answers, working on, and completing the assigned task) gave the largest contribution to the attitude and understanding variable with a percentage of 95.5%.

First Order CFA on Utilization and Operation (Util) of Maintenance Latent Variables

Table 11, the probability value was 0.05. This meant accepting H_0, so the population of covariance variance matrix was the same as the estimated covariance variance matrix. In addition, other conformity tests such as CFI, TLI, GFI, and AGFI had good fit criteria of 0.90 and RMSEA value = 0.000 or less than 0.08. Therefore, the overall model was a good fit and did not need modification. The next step was to calculate the CR value to see the reliability of the latent variable.

In latent UO, all indicators were significant. This showed that these indicators could explain the presence of latent UO. The Util2 indicator (utilization and operation of infrastructure at the planting phase) was an indicator that gave the largest contribution in explaining the latent UO because it had a loading factor value of 0.990 and $R^2 = 0.981$ (the largest) with the minor error of 0.018. The value of construct reliability can be obtained by using the formula 8 as follows:

$$CR = \frac{\left[\sum_{i=1}^{n}\lambda_i\right]^2}{\left[\sum_{i=1}^{n}\lambda_i\right]^2 + \left[\sum_{i}^{n}\delta_i\right]} = \frac{(3.850)^2}{(3.850)^2 + (0.289)} = 0.981 \quad (8)$$

The CR value of the latent variable UO was 0.981. This value was greater than 0.7 or 0.5. This meant that the latent variables of utilization and operation had good reliability.

Second Order Confirmatory Latent Variable of Participation

The second-order CFA for the participation variable consisted of 3 indicators, i.e., leadership, attitude & understanding, and utilization & operation.

Fig. 5 is the standardized estimation value of the second-order CFA farmers' participation in water management. The test results showed the value of df = 132, which indicated the over-identified model. Then the evaluation stage could be carried out for the suitability of the model.

Table 13 showed only the value of CFI = 0.903 (≥ 0.90) that suited the criteria, while the other criteria were not. Therefore, the overall model was not good (not fit). Therefore, the initial model needed modification. Modification of the model was done by selecting the largest MI value, which was presented in the following table:

Table 14 is the value of M.I. selected for the modification of the participation second-order model. The following Fig. 6 presents the results of the model modification.

In Figure 6, the df = 94 meant that the model was over-identified. The results of the feasibility test of the modified model were presented in Table 15 below:

Table 15 was the GOF result of the modified model. Even though the probability value was less than 0.05 (reject H_0: the estimated population covariance was not the same as the sample/model covariance did not match the data), but other criteria such as RMSEA, CFI, TLI, GFI, and AGFI was suitable so that the model can be accepted. In the reliability test, the value of the second-order reliability construct of participation was 0.989. The CR value was more than 0.7 or 0.5 (high reliability), so there was high consistency in measuring

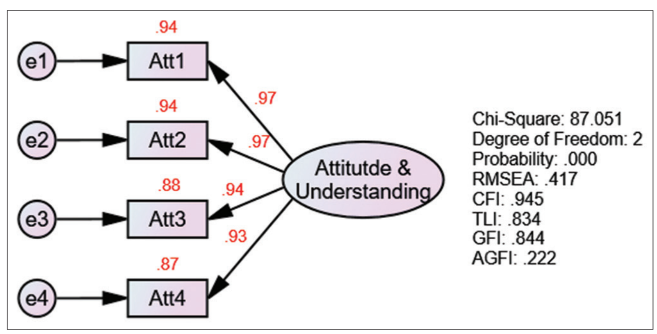

Fig 4. CFA Attitude and Understanding Latent Variables

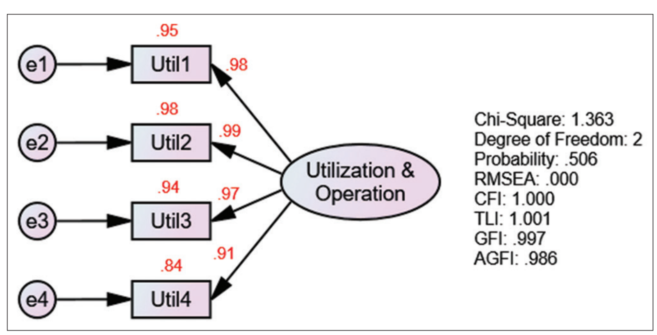

Fig 5 .CFA Latent Variables of Utilization and Operation

Table 8: Goodness of Fit Model CFA on Attitude and Understanding Latent Variables

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	87.051	Expected small
Probability	≥ 0.05	0.000	Poor
RMSEA	≤ 0.08	0.417	Good fit
CFI	≥ 0.90	0.945	Good fit
TLI	≥ 0.90	0.834	Poor
GFI	≥ 0.90	0.844	Poor
AGFI	≥ 0.90	0.222	Poor

Table 9: Goodness of Fit Modification Model CFA of Attitude and Understanding Latent Variables

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	0.236	Expected small
Probability	≥ 0.05	0.627	Good fit
RMSEA	≤ 0.08	0.000	Good fit
CFI	≥ 0.90	1.000	Good fit
TLI	≥ 0.90	1.000	Good fit
GFI	≥ 0.90	1.000	Good fit
AGFI	≥ 0.90	0.995	Good fit

Table 10: R^2 Contribution in Attitude and Understanding Indicators Before and After Modification

Indicators	Loading Factor	R^2	Loading Factor	R^2
	Before		After	
Att1	0.968	0.938	0.975	0.950
Att2	0.970	0.941	0.977	0.955
Att3	0.939	0.882	0.919	0.845
Att4	0.932	0.869	0.911	0.830

Table 11: Goodness of Fit Utilization and Operation Latent Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	1.363	Expected small
Probability	≥ 0.05	0.506	Good fit
RMSEA	≤ 0.08	0.000	Good fit
CFI	≥ 0.90	1.000	Good fit
TLI	≥ 0.90	1.001	Good fit
GFI	≥ 0.90	0.997	Good fit
AGFI	≥ 0.90	0.986	Good fit

the latent construct. After being modified in the value of R^2 and loading factor, the most significant contribution indicator was Util2 (utilization and operation of infrastructure at the planting phase). The contribution of the Util2 indicator made up the latent variable of participation, 98.2%.

Table 12: Parameter Estimation of CFA Latent Variable of Utilization and Operation

Indicator	Loading Factor	Error Variance	R^2	P-Value	Resolve
Util1	0.977	0.046	0.954	0.000	Significant
Util2	0.990	0.018	0.981	0.000	Significant
Util3	0.968	0.061	0.937	0.000	Significant
Util4	0.915	0.164	0.954	0.000	Significant

Table 13: Goodness of Fit Second Order Participation Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	971.486	Expected small
Probability	≥ 0.05	0.000	Poor
RMSEA	≤ 0.08	0.161	Poor
CFI	≥ 0.90	0.903	Good fit
TLI	≥ 0.90	0.888	Poor
GFI	≥ 0.90	0.683	Poor
AGFI	≥ 0.90	0.589	Poor

Table 14: Modification Indexes Value

Covariances			M.I.	Covariances			M.I.
e19	<->	e20	88.850	e5	<->	e19	44.563
e17	<->	e21	8.585	e5	<->	e16	6.025
e16	<->	e19	4.256	e5	<->	e11	9.006
e14	<->	e15	5.299	e4	<->	e20	76.824
e13	<->	e20	13.632	e4	<->	e19	8.665
e13	<->	e19	18.307	e4	<->	e13	10.385
e12	<->	e19	7.466	e3	<->	e16	35.569
e11	<->	e19	6.537	e3	<->	e14	14.544
e11	<->	e17	20.338	e3	<->	e11	12.856
e10	<->	e20	19.456	e3	<->	e10	11.877
e9	<->	e12	12.654	e3	<->	e8	22.261
e9	<->	e11	19.912	e2	<->	e16	17.931
e8	<->	e11	15.195	e2	<->	e14	11.708
e8	<->	e9	20.847	e2	<->	e5	39.743
e7	<->	e14	8.901	e2	<->	e4	40.112
e5	<->	e21	21.492	e1	<->	e5	6.545
e5	<->	e20	93.103	e1	<->	e2	30.306

Table 15: The Modification Goodness of Fit of Second-Order Participation Variable

Goodness of fit index	Cut off value	Model result	Resolve
χ^2 - Chi square	-	137.414	Expected small
Probability	≥ 0.05	0.002	Poor
RMSEA	≤ 0.08	0.044	Good fit
CFI	≥ 0.90	0.995	Good fit
TLI	≥ 0.90	0.992	Good fit
GFI	≥ 0.90	0.945	Good fit
AGFI	≥ 0.90	0.901	Good fit

DISCUSSIONS

Participation is a collaborative decision-making process hoping that it will affect decision-makers (Becker and Gerhart, 1996; Brager et al., 1987). Leader involvement is a form of participation to determine a goal. Leadership is

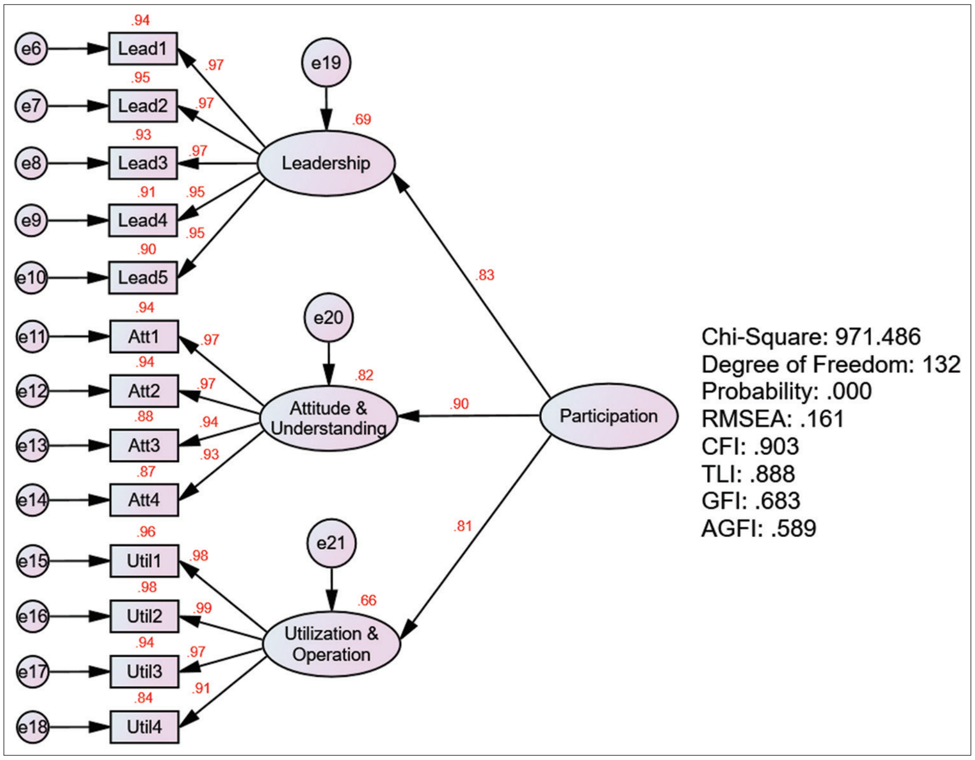

Fig 6. Second Order CFA

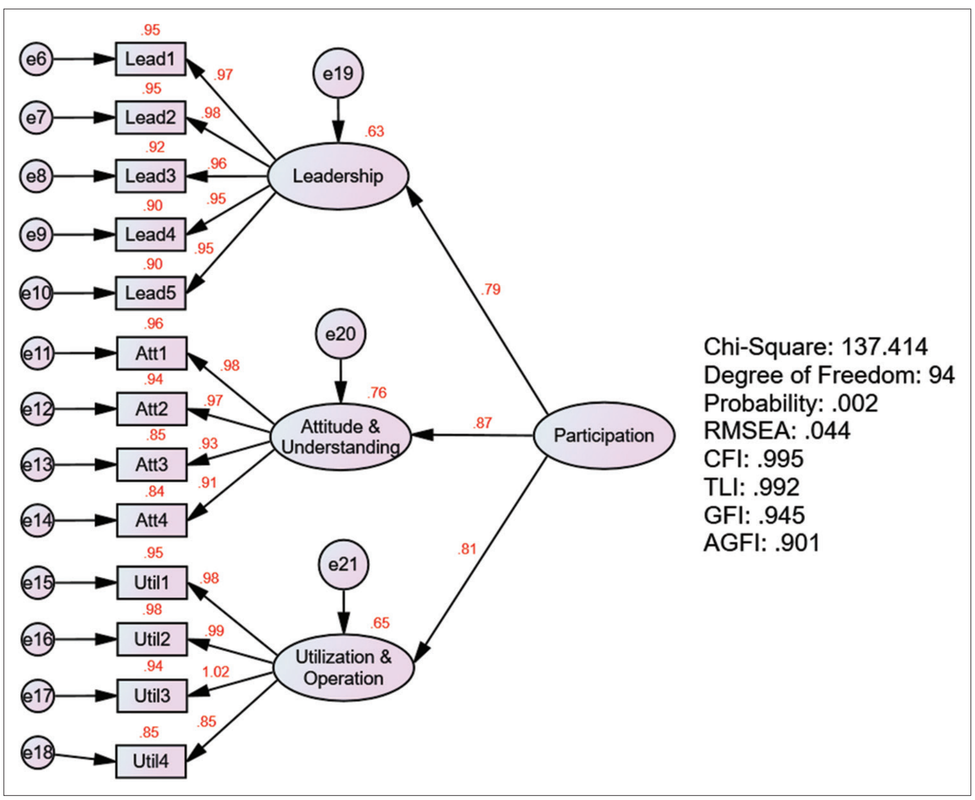

Fig 7. The Modification of Second-Order Participation Variable

an attitude that every group leader must-have. Therefore, the role of the leader is significant in decision-making (Margerison and Glube, 1979). In addition, other group members will be involved when participation is applied in planning. This is done to structure steps and make decisions regarding the objectives of group operations.

In this study, leadership was one of the variables that determine the attitudes and understanding of each member in participating. Attitude was an important study subject used to predict social behavior (Petty et al., 1997). Several studies had shown a relationship between attitudes and participation. Research Bagherian et al., (2011), stated that farmers who had a negative attitude towards government regulations regarding wetlands were less likely to want to participate in water management. His research in Iran resulted in the finding that the attitude variable was essential for participation in the program and understanding the participation behavior of certain groups. If the farmer had a positive attitude, this could support in achieving the group's program goals. Farmers who have a good attitude and understanding of water resources tend to want to participate in its management. In the group, the attitude of responding, giving answers, working on, and completing the assigned tasks would positively influence participatory management (Davidescu et al., 2020; Saiz-Rubio and Rovira-Más, 2020).

Tidal lowland agriculture, which is highly dependent on water, requires wise use. Farmers not only take advantage of water resources but also must manage them properly. Water management on tidal land at the research site was assisted by water infrastructure such as water channels equipped with sluice gates. This floodgate functions to hold water in the canal when needed and disposed of water when it is excessive. In addition, these water-gates and channels also function to wash the land from acidity and remove chemical residues on the land (Imanudin et al., 2010; Sulaiman et al., 2019). In Tafarini et al. (2021) research, the management of this infrastructure requires costs. Not only management but maintenance also requires costs to support efficient utilization. In its utilization, farmers must be equipped with an understanding of the tidal irrigation system and the use of water infrastructure. MacDonald (2019) research, stated that the operation and maintenance of water infrastructure were carried out in a participatory manner by the water user association group. Water infrastructure maintenance was carried out regularly so that it can be utilized optimally for the sustainability of water management in tidal areas (Regulation of the Minister of Public Works and Public Housing, 2015; Saiz-Rubio & Rovira-Más, 2020; Tafarini & Yazid, 2019). Therefore, the variables of leadership, attitude & understanding, and utilization & maintenance are closely related to farmer participation in water management.

Based on the confirmatory factor analysis results, it was confirmed that participation was formed if the variables of leadership, attitude & understanding, and utilization & maintenance were the benchmarks for the success of tidal water management. The specification of indicators for each variable was an indicator in water management in tidal agriculture. The success and sustainability of water management encourage sustainable agriculture. In Pretty (1995) research, the success of sustainable agriculture must be supported by the group's participation responsible for its management. Leadership was an essential factor in decision-making. A leadership attitude needs to be possessed by a leader and its members to play an active role in carrying out their duties (Ejimabo, 2015). Research of Al-Rawahi & Al-Yaaribi (2013), stated that a person's attitudes and understanding influence various aspects of group participation.

CONCLUSION

Questionnaire data that had been collected accurately measured four latent variables and 18 constituent indicators. The constituent indicators of the latent variables of participation, leadership, attitude & understanding, and utilization & operation had a significant p-value, indicating that all loading factor values had a significant (unidimensional) effect on the latent variables in first-order confirmatory factor analysis (CFA). However, there were some estimated that required modification to get a good measurement model. Therefore, the value of the contribution of latent variables and indicators varies. The most critical indicators that make up the latent variables of participation in the second-order contribution are Util2. Indicator Util2 is the utilization and operation of water infrastructure used at the planting stage.

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Authors' contributions

Meitry Firdha Tafarini wrote and translated the manuscript, collected theories, and built the model analysis. Muhammad Yazid was the corresponding author, and he contrived this research. Muh Bambang Prayitno and Muhammad Faizal provided guide in collected data and corrected the content of the manuscript. F.X. Suryadi corrected the English and typewriting. Khairul Fahmi Purba assisted in data collection and data entry. All authors discussed the result and contributed to the final manuscript.

Conflict of Interest

The authors declare no conflict of interest.

Ethical Statement

This article does not contain any studies that would require an ethical statement.

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