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Effectiveness of Agricultural Extension on Paddy Rice Farmer's Baubau City, Southeast Sulawesi, Indonesia

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Abstract: Agricultural extension workers play an essential role in the productivity of agricultural systems. Based on the actual conditions in the field, it can be seen that the level of extension services still needs to be higher due to a lack of human resources in the field of extension services. This research was conducted to determine the effectiveness of agricultural extension services andthe factors that influence the effectiveness of agricultural extension to farmers in Baubau City, Indonesia. The analytical method includes exogenous latent variables: human resources, technological progress, farming capital, farmer age, education, and farming experience. The effectiveness of agricultural extension is used as an endogenous latent variable. The research sample consisted of 110 rice farmers in Baubau City, and the Slovin formula was used to calculate the sample. The data collection for this research was carried out by distributing questionnaires to respondents, in-depth interviews, and direct observation in the city of Baubau. Using the AMOS application, quantitative analysis was carried out through structural equation modeling (SEM). The study results show that: (1) The factors that influence the effectiveness of agricultural extension in Baubau City are farming capital, farmer age, education, farming experience, and human resources, and (2) the influence of these factors on the effectiveness of agricultural extension is as follows: if the farming capital is high, human resources can be increased. In addition, the higher the farmer's age, the lower the need for human resources. It is also noted that higher farmer education contributes to increased human capital, and increased experience in farming is associated with increased human capital. Thus, an increase in human resources will increase the effectiveness of agricultural extension. Significant factors that influence the effectiveness of agricultural extension in Baubau City, Southeast Sulawesi, are farming capital, farmer age, education, farming experience, and human resources.

Keywords: effectiveness; agricultural extension; paddy rice; Indonesia

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1. Introduction

Southeast Sulawesi has sufficient competence to support the Indonesian food development program because of the high availability of land and the potential for land productivity. Based on data on rice field areas in the rice planting season, Southeast Sulawesi has an area of 82,382 ha of raw rice fields (Data Landsat 8, 2021). The size of rice fields in Baubau city is 1375 ha; this indicates that the agricultural sector is one of the sectors with high priority in Baubau City (Abadi, 2019) [1]. However, rice production domestically is dominated by lowland rice production. Hence, the extension workers should increase their effectiveness in extension services for the lowland rice farmers.

Extension workers can contribute to the regulatory process by providing expertise and content for proposed, adopted, and restructured agriculture-related regulations. As extension agents directly interact with clients in the field, they can communicate the needs of stakeholder

groups. Therefore, they should be involved in the regulatory process. An evidence-based approach involving input from target groups and practitioners seems to be an inevitable strategy for the success of a sustainable land grant project (Fouladkhah, A., 2017) [2].

Extension agents are one of the supporting elements in the agribusiness sub-system. In principle, the agricultural extension supports all sub-systems in agribusiness. Specifically, in this study, extension workers play a role in supporting to increase the productivity of lowland rice. Hence, to increase the productivity of rice farming, extension workers are needed. The role of the extension worker is to provide guidance and knowledge in the form of the latest information or innovation to improve their farming system, ultimately increasing their crop yields. In addition, the purpose of agricultural extension is to change the behavior of farmers, for instance, their ability to adapt to situations and conditions that keep changing. Thus, they can improve their farming systems, increase production, and reduce the possibility of crop failure. While simultaneously improving their living standards.

However, there are some significant issues, such as a lack of active participation from agricultural extension workers and the difference in the extension worker-to-farmer ratio, leading to fewer extension workers for many farmers. This problem causes the workload of each extension worker to be quite heavy because either the extension area or the number of assisted farmer groups is quite large. Therefore, the current condition is forcing agricultural extension workers to work hard despite a limited number of workers, and they must be able to perform optimally to increase their work productivity.

The role of extension workers can increase sustainable agricultural productivity and food security (Olorunfemi, T. O., et al., 2020) [3]. One of the most crucial things is to ensure that using the agricultural extension and education programs has a positive impact on farmers (Salehi, M., et al., 2021) [4]. Consequently, the crucial role of extension workers is to create awareness among farmers to apply guidelines for food needs (Fiaz, S., et al., 2018) [5]. The findings of the study (Jamil, M.H., 2017) [6] show that the development of agricultural extension workers has a positive effect on the agricultural extension program.

Agricultural extension programs and policies can play an important role in achieving production (Mahir, M. E. A. E., & Abdelaziz, H. H. 2011) [7]. Additionally, this agricultural policy was discussed by (Baloch, M. A., & Thapa, G. B, 2019) [8], who said that agricultural policies must be implemented effectively to address the needs of farmers and the problems they face. One example is that the Government of Pakistan has adopted a policy of providing agricultural services to promote agricultural production by disseminating appropriate knowledge and technology to farmers (Baloch, M. A., & Thapa, G. B., 2018) [9].

The agricultural, industrial revolution has had an impact on efficiency and productivity in agricultural extension services in the agricultural sector (Nyarko, D. A., & Kozári, J. 2021) [10]. Furthermore, the effects of community-based strategies on food security have a positive impact (Wellard, K., et al., 2013) [11]. Therefore, it is suggested that extension services provide Information and Communication Technology training (ICT) for agricultural extension workers to improve extension services. In addition, according to (Umbara, D.S., Sulistyowati, L., Noor, T.I., and Setiawan, 2021) [12,13], the dissemination of agricultural technology information by utilizing the internet network is very helpful for agricultural extension workers in carrying out their main tasks. Information and Communication Technology can also facilitate the delivery of information and knowledge sharing between farmers, extension workers, and other stakeholders (Annor-Frempong, F., et al. (2006) [14]. The article (Haghighi, N. F., et al., 2008) [15] stated the perspective on the application of Information and Communication Technology in agriculture and some issues with using ICT in organizations; however, this is in contrast to (Diaz, R. T., et al. (2021) [16]). Furthermore, it was found that extension services in the study area are not sufficient when farmers face difficulties.

From the literature, it can be gathered that an agricultural extension worker plays an essential role in the productivity of a farming system. Based on the actual conditions in the field, it can be acknowledged that the extension service rate is low due to a lack of human resources in the extension field. Therefore, to solve the problems that arose from the current predicament, this study was conducted to determine the effectiveness of agricultural extension services. The primary purpose of this study is to determine the factors that influence the effectiveness of agricultural extension services to lowland rice farmers in Baubau City and to find out how these factors can affect the effectiveness of agricultural extension services.

2. Research Hypothesis

a. It is suspected that the variables of technological progress (X1), farming capital (X2), farmer age (X3), farmer education (X4), and farmer experience (X5) have a significant relationship and have a direct influence on human resources (Y1).
b. Allegedly, the variables of technological progress (X1), farming capital (X2), farmer age (X3), farmer education (X4), and farmer experience (X5) have a significant relationship and give an indirect effect but are thought to influence the variable effectiveness of agricultural extension (Y2).
c. It is suspected that the variable human resources (Y1) have a significant relationship with the variable effectiveness of agricultural extension (Y2).

3. Research Methods

3.1. Place and Time

This research is located in Baubau City, Southeast Sulawesi, and was carried out from January–July 2022.

3.2. Data Collection

Data collection techniques in this study were carried out using interviews, questionnaires, and observation. The measured variable is technological progress (X1), farming capital (X2), farmer age (X3) farmer education (X4), farmer experience (X5) human resources (Y1), and effectiveness of agricultural extension (Y2) (Figure 1).

3.3. Population and Sample

The population of this study was all farmers in Baubau City; 1257 people (Data from the Baubau City Agriculture Office, 2021). In addition, the population of agricultural extension workers in Baubau City is 26.

Simple random sampling was used. The sample measurements were calculated using the Slovin formula:

$$\mathrm{n} = \frac{N}{1 + N\,(E)^2} \quad (1)$$

$$\mathrm{n}_i = \frac{N_i}{N} \times \mathrm{n} \quad (2)$$

Description:
n = Number of samples
N = Population
e^2 = Precession set (5%)
n_i = Standard sample size i
N_i = Population size i

The sample size was determined with an error rate of 10% or based on the desired level of confidence (precision) of 90%, and the sample size based on the Slovin formula amounted to 110 respondents. The study sample for extension agents was based on the population of extension workers in Baubau City, which amounted to 26 personnel, from which 30% of the total was sampled, resulting in 8 extension workers.

The data collection techniques used to carry out the study were questionnaires, direct interviews, and observations to determine the characteristics and behavior of the research object. The data obtained were analyzed descriptively and quantitatively using the SEM method (*structural equation modeling*)—Software AMOS (*Analysis of Moment Structure*).

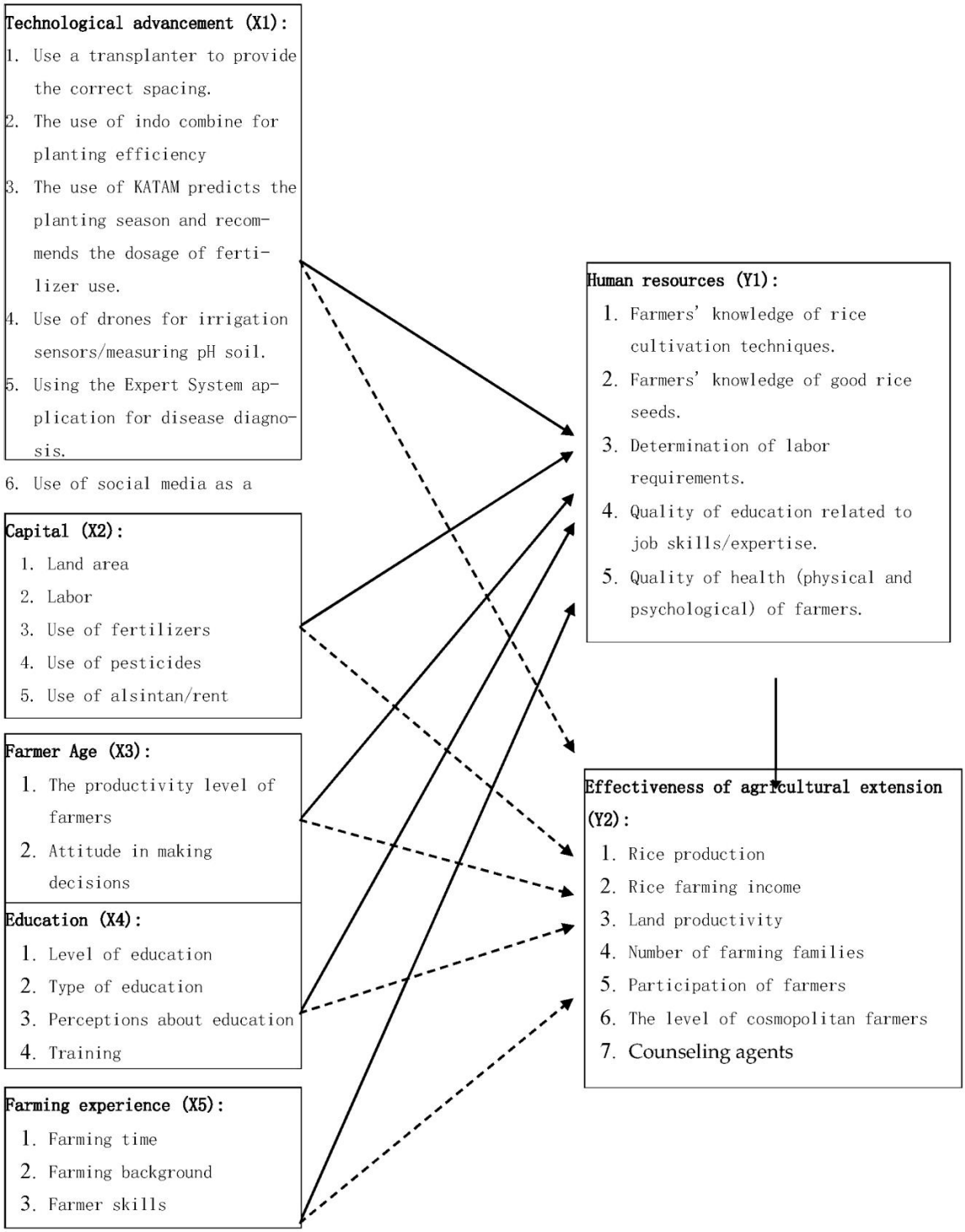

Figure 1. Constructs, Indicator, and Code Variable.

3.4. Analysis Method

3.4.1. Descriptive Statistical Analysis

Descriptive statistical data was interpreted using the TCR criteria (Respondent Achievement Level), and the following formula was used:

$$\text{TCR} = \frac{Mean}{Skor\ Max} \times 100 \quad (3)$$

The percentage formula used in this study is as follows:

$$P = \frac{f}{N} \times 100\% \quad (4)$$

Description:
P = Percentage Number
f = The number of frequencies of each answer that has become the respondent's choice
N = The number of frequencies or the number of individuals
To determine the level of criteria with a descriptive analysis of the percentage, which is divided into five indicators, namely,

3.4.2. Quantitative Analysis

SEM (structural equation modeling) analysis in this study was carried out using AMOS 24 software to answer problems related to variables that influence the effectiveness of agricultural extension in Baubau City.
The formula used in this study is as follows:

$$\text{Equality 1 Y1} = \beta_0 + \beta_1 X_2 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e \quad (5)$$

$$\text{Equality 2 Y1} = \beta_0 + \beta_1 Y_1 + e \quad (6)$$

Description:
Y1 = Human Resources
Y2 = Effectiveness of Agricultural Extension
β = Constant
E = Standard error
X1 = Technology advances
X2 = Capital
X3 = Farmer Age
X4 = Education
X5 = Farming experience

4. Results

The demographic characteristic of the farming communities involves 96% of male and 4% of female farmers (Table 1). There is a division of household tasks between husband and wife. Based on in-depth interviews with several respondents, they stated that working in the fields is the husband's duty while the wife takes care of the household. Results based on age indicated that 34% of farmers were 36–45 years old, and 6% were under 25 years old. Farmers who work at the productive age will be better and more optimal than non-productive age (Productive age 15–64). In addition, age can also be used as a benchmark to see the activities of farmers at work (Hasyim, 2006) [17].

Table 1. TCR criteria.

No.	Scale Range	TCR
1	90–100%	Very good
2	80–89.99%	Good
3	65–79.99%	Enough
4	55–64.99%	Not good
5	0–54.99%	Not good

It was revealed that the respondents with non-educational levels were 10%. Respondents with their last education at the elementary, junior, and senior high school levels were 41%, 13%, and 31%, respectively; at the tertiary level added, 5% (Soehardjo and Patong, D. 1999) [12]. Higher levels of education result in a more straightforward implementation of innovations. Farmer education is not only oriented toward increasing production but the social life of the farming community. On the other hand, farmers with a high education level will be relatively faster in implementing technology adoption and innovation. Farmers who have low education may have difficulty implementing the adoption of innovation quickly. The level of education possessed by farmers depicts the knowledge and insight a farmer has in applying technology and innovation to increase farming activities (Lubis, 2000) [18]. Demographic characteristics based on the main occupation of farmers show that farming is the respondents' main occupation, totaling 97%. In comparison, the remaining 3% of the main occupation are civil servants, and farming is their side employment.

Based on the study results, farmers with a land area of less than 1 ha was 16%, 1 to 5 ha was 82%, and more than 5 ha was 2%. The number of farmers that own their land is 93%, and 6% of the farmers are tenants, while the remaining 1% amounts to farmers being landowners and tenants. It is important to note that more land ownership means more potential to increase productivity and efficiency by adopting modern technology. Land tenure is vital in spreading and adopting modern agricultural practices among farming communities (Aldosari et al., 2019) [19].

Next, the results show that a significant percentage of the farmers had more than 10 years of experience resulting in a total of 76%, followed by farmers with 5–10 years with 14% and farmers with less than 5 years of experience with 10%. The farming experience significantly affects farming activities, as evident in the production results. Farmers who have been farming for a long time have high knowledge, experience, and skills in running a farm. Farming experience is divided into three categories, namely less experienced (<5 years), moderately experienced (5–10 years), and experienced (10 years). Farmers have different farming experiences or lengths of farming (Soehardjo and Patong, D. 1999) [12].

Furthermore, it can be seen that respondents have chosen "hereditary" as their farming background surmounting 90% or as many as 99 people from the total number of respondents. None of the respondents chose "has the farming ability" as a farming background; in this case, the respondent's last education determines the farming background. The remaining percentages recorded for farming backgrounds are "economic need, availability of adequate land, the ability to farm and willingness based on agriculture as a promising field." The percentages for each are as follows: 3%, 4%, 1%, and 2%, respectively.

An extension work area is a place or an area that becomes the territory of authority in carrying out its duties as an extension worker, whether within the ward, sub-district, district/city, or wider area. The extension worker's work area can affect productivity in carrying out his duties. Meanwhile, the distance from the working area is the distance from the instructor's residence to the extension location. In Table 2, it can be seen that each respondent has a different work area and distance from the work area. The distance from the farthest working area is 21 km, and the closest is 5 km.

Table 2. Percentage Descriptive Analysis Criteria.

Number	Percentage	Criteria
1.	0–20%	Very low
2.	21–40%	Low
3.	41–60%	Moderate
4.	61–80%	High
5.	81–100%	Very high

Duration as an Extension refers to this study; each respondent has been an extension worker from the time of appointment until this research is carried out, expressed in units of years. The length of time as an extension worker determines the level of experience each agent has. In Table 3 the duration of an extension worker is divided into three categories: less experienced (<5 years), moderately experienced (5–10 years), and experienced (>10 years). The highest percentage (63%); five out of eight agents have more than 10 years of experience as an extension worker. While extension agents have moderate experience, equal to two out of eight (25%), and extension agents with less than five years of experience totaled one out of eight (12%). Respondents who generally do farming are male (96%) and female (4%), based on interviews that work in the fields is the main task of a husband (male). In addition, the dominant number of respondents is those aged 46–55 years. During the productive age, farmers are more receptive to ideas and innovation. In addition, the level of education affects increasing the skills and knowledge of farmers. The last education of farmers is 41% in elementary schools. In addition, land area, land ownership status, time of farming, and farming background affect rice production and farmers' income.

Table 3. Demographic Characteristics Data of Rice Farmers in Baubau City, Southeast Sulawesi.

Gender	n	%	Age (Years)	n	%
Male	106	96	Less than 25	7	6
Female	4	4	25–35	25	23
Total	110	100	36–45	17	15
			46–55	37	34
			More than 55	24	22
			Total	110	100
Last Education	n	%	Main Occupation	n	%
No Education	11	10	Farmers	107	97
Elementary school	45	41	Other than farmers (PNS)	3	3
Junior High school	14	13	Total	110	100
Senior High school	34	31			
Higher Education	6	5			
Total	110	100			
Land Area (ha)	n	%	Land Ownership Status	n	%
Less than 1	18	16	Owner	102	93
1–5	90	82	Tenant/tenant	7	6
More than 5	2	2	Owner and tenant	1	1
Total	110	100	Total	110	100
Time of farming (years)	n	%	Farming background	n	%
Less than 5	11	10	Hereditary	99	90
5–10	15	14	Economic needs	3	3
More than 10	84	76	Availability of adequate land	5	4
Total	110	100	Has the ability to farm	1	1
			Willingness from within because farming is a promising field	2	2
			Total	110	100

n = Total; % = Percentage.

Table 4 shows the distance agricultural extension work areas. The longest working distance is 21 km, while some extension workers live in their working area.

Table 4. Data on Demographic Characteristics of Agricultural Extension Respondents based on Working Area and Distance from Work Area Baubau City, Southeast Sulawesi.

No.	Working Area	Distance from Working Area (Km)
1	Lea-lea Subdistrict	15
2	Tampuna Subdistrict	21
3	Liabuku Subdistrict	9
4	Bungi Subdistrict and Lea-Lea Subdistrict	10
5	Ngkaring-ngkaring Subdistrict	5
6	Waliabuku Subdistrict	13
7	Lowu-lowu	15
8	Subdistrict Kalia-lia	15

The status of the extension workers refers to the position an agent holds, which corresponds to their employment descriptions. Table 5 displays that of the eight surveyed workers, 63% (five agents) are Civil Servants, 12% are honorary employees, and 25% are THL-TBPL position holders.

Table 5. Data on Demographic Characteristics of Agricultural Instructor Respondents in Baubau City, Southeast Sulawesi.

Duration as an Extension (Years)	n	%	Status	n	%
Less than 5	1	12	Civil Servants	5	63
5–10	2	25	Honorary Employee	1	12
More than 10	5	63	THL-TBPL	2	25
Total	8	100	Total	8	100

THL-TBPL: Agricultural extension workers.

4.1. Descriptive Statistical Analysis

4.1.1. Technological Progress Variables

Based on Table 6, the average Technological Progress Variable is 24.91, with a respondent's level of achievement, 64.5%, which favors the Not good category. Thus, it can be said that technological advances have less than the desired effect on agricultural extension. The indicator with the lowest TCR value in the table below is the use of *indo combine harvester*, with an average score of 23.68, gravitating to the Not good category. While the indicator with the lowest average score is for the use of *drones* (irrigation sensor/measuring soil pH) which is 12.94, and the TCR value is 80.9 falling into the Good category.

Table 6. Frequency Distribution of Technological Progress Variables (X1) in the study of Factors Affecting the Effectiveness of Agricultural Extension on Paddy Rice Farming Businesses in Baubau City, Southeast Sulawesi, 2022.

No.	INDICATOR	N	Max.	Mean	TCR	CATEGORY
1	Use of transplanter	110	52	27.22	52.3	Not good
2	Use of *indo* combine harvester	110	52	23.68	45.5	Not good
3	Use of KATAM (predicted planting season)	110	50	38.22	76.4	Enough
4	Use of KATAM (fertilizer dose)	110	50	35.51	71.02	Enough
5	Use of drones (irrigation sensor/measuring soil pH)	110	16	12.94	80.9	Good
6	Use of expert system applications	110	17	13.35	78.5	Enough
7	Use of social media	110	50	23.57	47.1	Not good
	Average			24.91	64.53	Not good

The impact of the extension approach on the use of technology and food security was found to be positive (Wellard, K., et al. (2013) [11]). Dissemination of agricultural technology information is helpful for agricultural extension workers in carrying out their main tasks. (Umbara, D.S et al., 2021) [13]. In recent years, the agricultural industry has experienced an increase in the application of Information and Communication Technology globally. This new revolution is said to have had an impact on efficiency and productivity in agricultural extension services in the agricultural sector (Daniel et al., 2021) [10]. Furthermore, Information and Communication Technology can be used in a cost-effective and practical way to facilitate information sharing and knowledge sharing among farmers, extension workers, and other stakeholders (Joseph Kwarteng, 2006) [14]. This new revolution is said to have impacted efficiency and productivity in agricultural extension services in the agricultural sector (Daniel Ayisi Nyarko and József Kozári, 2021) [10] and attitudes towards the application of Information and Communication Technology in agricultural extension, the extent of the problems faced by extension organizations to the use of ICT, knowledge of ICT, and personal characteristics (Negin Fallah Haghighi et al., 2008) [15].

4.1.2. Farming Capital Variable

Based on Table 7, the average Farming Capital variable is 38.16 with a TCR value of 68.12, portraying the sufficiency of the indicator. In other words, the influence of the farming capital variable on the effectiveness of agricultural extension is satisfactory. On the other hand, the labor indicator has the lowest TCR value of 45.1, and the average score is 23.03, which is the indicator value with the lowest score; hence, it is portrayed in the Not good category. In comparison, the indicator with the highest TCR value is the use of fertilizer, which is 82.4 with an average value of 42.85 and is present in the Good category.

Table 7. Frequency Distribution of Farming Capital Variables (X2) in Research on Factors Affecting the Effectiveness of Agricultural Extension on Paddy Rice Farming in Baubau City, Southeast Sulawesi, 2022.

No.	INDICATOR	N	Max.	Mean	TCR	CATEGORIES
1	Land area	110	54	39.60	73.3	Sufficient
2	Labor	110	51	23.03	45.1	Not good
3	Fertilizer use	110	52	42.85	82.4	Good
4	Pesticide use	110	56	42.36	75.7	Enough
5	Agricultural machinery use	110	67	42.98	64.1	Poor
	Average			38.16	68.12	Enough

4.1.3. Farmer Age Variable

In Table 8, the average Farmer Age variable is 38.73 with a TCR value of 67.93 and is in the adequate category. Therefore, it can be stated that the influence of the age variable of farmers on the effectiveness of agricultural extension is reasonably influential. The attitude indicator in decision-making has the highest average value of 41.33 and the TCR value of 72.5; hence, classified into the Enough Category. While the indicator with the lowest average value, namely the acceptance of information, is 36.05 with a TCR value of 63.2, which falls in the designated category of Poor.

Table 8. Frequency Distribution of Farmer Age Variable (X3) in the study of Factors Affecting the Effectiveness of Agricultural Extension on Rice Field Farming in Baubau City, Southeast Sulawesi, 2022.

No.	INDICATOR	N	Max.	Mean	TCR	CATEGORY
1	Farmer Productivity Level	110	57	38.82	68.1	Enough
2	Attitude in Making Decisions	110	57	41.33	72.5	Enough
3	Acceptance of Information	110	57	36.05	63.2	Low
	Average			38.73	67.93	Adequate

4.1.4. Farmer Education Variable

In Table 9, the average Farmer Education variable is 14.56 with a TCR value of 30.20 which is Not good. In other terms, the influence of farmers' education on the effectiveness of agricultural extension is not present. The Perception indicator of Education has the lowest average score of 13.95 and the TCR value of 25.8, indicating that the variable component is in a Not good category. Likewise, the other three indicators also fall into the Not good category.

Table 9. Frequency Distribution of Farmer Education Variables (X4) in the study of Factors Affecting the Effectiveness of Agricultural Extension on Paddy Rice Farming in Baubau City, Southeast Sulawesi, 2022.

No.	INDICATOR	N	Max.	Mean	TCR	CATEGORY
1	Education Level	110	57	18.25	32.01	Not good
2	Type of Education	110	51	15.58	30.6	Not good
3	Perception about Education	110	54	13.95	25.8	Not good
4	Training	110	58	18.48	32.4	Not good
	Average			14.56	30.20	Not good

4.1.5. Farming Experience Variable

Referring to Table 10, the average Farming Experience variable was 37.45 with a TCR value of 64.8, indicating that the experience variable categorizes in the Poor section. From the three indicators, it shows that the farming background indicator has an average value of 28.13 and a TCR value of 50.2 while being categorized as Not good; however, the indicators of the farming time and farmer skills are in the Enough category with TCR values of 67.5 and 76.7, respectively.

Table 10. Frequency Distribution of Farming Experience Variables (X5) in the study of Factors Affecting the Effectiveness of Agricultural Extension on Paddy Rice Farming in Baubau City, Southeast Sulawesi, 2022.

No.	INDICATOR	N	Max.	Mean	TCR	CATEGORIES
1	Farming time	110	60	40.51	67.5	Enough
2	Farming background	110	56	28.13	50.2	Not good
3	Farmers skills	110	57	43.72	76.7	Enough
	Average			37.45	64.8	Poor

4.1.6. Extension Problem Variables

Table 11 shows that the average variable of Extension Problems is 35.28 with a TCR value of 83.26, indicating that these variables are in a Good category. The indicator of the number of assisted farmers has an average value of 44.00 and shows a TCR value of 78.6 which means it is in the Enough category. The extension media indicator has an average value of 25.63. It shows its TCR value of 91.5, presenting as Very Good, followed by indicators of the experience of the extension worker, the frequency of extension, the amount of working time of the agricultural instructor, the extension method, and the extension material, which were all in the Good category. Finally, the indicator of the distance of the extension location is in the Enough category.

Table 11. Frequency Distribution of Extension Problems Variables (X6) in the study of Factors Affecting the Effectiveness of Agricultural Extension on Paddy Rice Farming in Baubau City, Southeast Sulawesi, 2022.

No.	INDICATOR	N	Max.	Mean	TCR	CATEGORIES
1	Number of Assisted Farmers	8	56	44.00	78.6	Enough
2	Distance of Extension Locations	8	21	15.00	71.4	Enough
3	Total Working Time of Agricultural Instructor	8	23	19.88	86.4	Good
4	Extension Media	8	28	25.63	91.5	Very Good
5	Extension Methods	8	31	25.38	81.9	Good
6	Extension Frequency	8	44	38.13	86.7	Good
7	Extension Materials	8	46	37.13	80.7	Good
8	Extension Experience	8	53	47.13	88.9	Good
	Average			35.28	83.26	Good

4.1.7. Extension Materials

Based on Table 12, the average of the Extension Materials variable is 3.53, with a TCR value of 83.94, indicating that this variable is in the Good category. The fertilization, harvesting, and post-harvest indicators have the same average value of 3.63 and the same TCR value of 90.75, indicating that the three indicators are in the Very Good category. They are then followed by indicators of good planting time, seed sowing, and planting, which all have the same average value of 3.50 and the same TCR value of 87.5, indicating that the variable components are in the Good category. At the same time. the nursery and maintenance indicators are in the Enough category.

Table 12. Frequency Distribution of Extension Material Variables (X7) in the study of Factors Affecting the Effectiveness of Agricultural Extension on Paddy Rice Farming in Baubau City, Southeast Sulawesi, 2022.

No.	INDICATOR	N	Max.	Mean	TCR	CATEGORIES
1	Good Planting Time	8	4	3.50	87.5	Good
2	Tillage	8	5	4.00	80	Good
3	Nurseries	8	4	2.63	65.75	Enough
4	Nurseries	8	4	3.50	87.5	Good
5	Planting	8	4	3.50	87.5	Good
6	Maintenance	8	5	3.75	75	Enough
7	Fertilizing	8	4	3.63	90.75	Very good
8	Harvesting	8	4	3.63	90.75	Very good
9	Post-harvest	8	4	3.63	90.75	Very good
	Average			3.53	83.94	Good

4.1.8. Human Resources

Table 13 shows that the average score of the Human Resources variable is 4.20, and the TCR value is 84.12, hence, summarizing the variable in the Good category. Of the five indicators below, one indicator is in the Not good category, namely the quality of education related to work skills/expertise, with an average value of 1.80 and a TCR value of 36. In contrast, the other four indicators are in the Very good category.

Table 13. Frequency Distribution of Human Resources Variables (Y1) in the study of Factors Affecting the Effectiveness of Agricultural Extension on Paddy Rice Farming in Baubau City, Southeast Sulawesi, 2022.

No.	INDICATOR	N	Max.	Mean	TCR	CATEGORIES
1	Farmers' knowledge of rice cultivation techniques	110	5	4.90	98	Very good
2	Farmers' knowledge of good rice seeds	110	5	4.92	98.4	Very good
3	Determination of labor needs	110	5	4.65	93	Very good
4	Quality of education related to Skills/work skills	110	5	1.80	36	Not good
5	Health quality (physical and psychological) of farmers	110	5	4.76	95.2	Very good
	Average			4.20	84.12	Good

4.1.9. Effectiveness of Agricultural Extension

The results of Table 14 show that the average variable of Extension Effectiveness Agriculture is 3.73 and has a TCR value of 74.76 which means that the variable is in the Fair category. This Agricultural Extension Effectiveness variable has six indicators, of which one indicator is in the Not good category: the number of farming families. Then two indicators are in the Very good category: farmer participation and the level of cosmopolitan farmers with TCR values of 97 and 92.6. They were then followed by indicators of rice farming income in the Good category and rice production and land productivity in the Enough category.

Table 14. Frequency Distribution of Extension Problems Variables (X6) in the study of Factors Affecting the Effectiveness of Agricultural Extension on Rice Field Farming in Baubau City, Southeast Sulawesi, 2022.

No.	INDICATOR	N	Max.	Mean	TCR	CATEGORIES
1	Rice Production	110	5	3.65	73	Enough
2	Rice Farming Income	110	5	4.20	84	Good
3	Land Productivity	110	5	3.65	73	Enough
4	Number of Farmer Families	110	5	1.45	29	Not good
5	Farmer Participation	110	5	4.85	97	Very good
6	Cosmopolitan Level Farmers	110	5	4.63	92.6	Very good
	Average			3.73	74.76	Fair

4.2. Analysis of Structural Equation Modeling (SEM)

4.2.1. Evaluation of Measurement Model

This research model consists of 7 (seven) constructs, including the variables of Technological Progress (X1), Capital (X2), Farmer Age (X3), Education (X4), Farming Experience (X5), Human Resources (Y1), and Effectiveness of Agricultural Extension (Y2). Evaluation of the measurement model is a stage to test the validity and reliability of a construct (Figure 2).

1. Validity Testing

Construct validity testing is intended to determine whether the indicators used in measuring latent variables are valid. The validity of each indicator in measuring the latent variable is indicated by the size of *the loading factor* (*Standardized Weights*). An indicator is declared valid if *the indicator's loading factor is positive and* greater than 0.5. The results of the validity test are presented in Table 13.

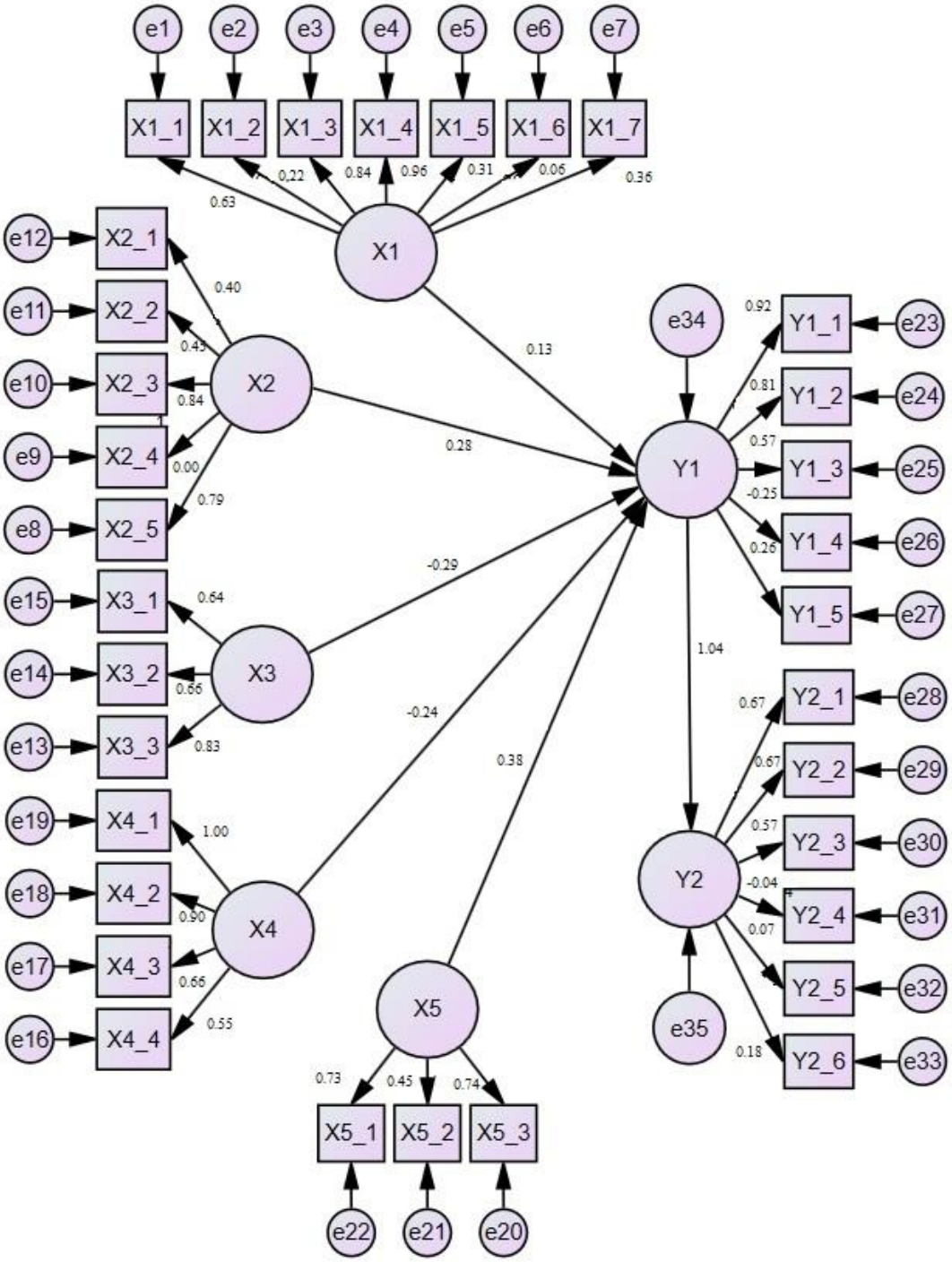

Figure 2. Path Diagram.

Table 15 shows that the question indicators X1_2, X1_5, X1_6, and X1_7, which measure the Technological Progress variable (X1), are declared invalid because they produce a loading factor value of less than 0.5. Then the question indicators X2_1 and X2_2, which measure the Modal variable (X2), are declared invalid. Furthermore, the question indicators X5_2, Y1_4, and Y1_5, which measure the variables of Farming Experience (X5) and Counseling Problems (Y1), are declared invalid because they produce a loading factor value of less than 0.5. Then the question indicators Y2_4, Y2_5, and Y2_6, which measure the Agricultural Extension Effectiveness variable (Y2), are declared invalid because they produce a loading factor value of less than 0.5.

Table 15. Construct and Validity Test.

Variable	Indicator	Loading Factor	Criteria	AVE
Technology Advances (X1)	X1_1	0.626	0.5	0.326
	X1_2	0.220	0.5	
	X1_3	0.837	0.5	
	X1_4	0.956	0.5	
	X1_5	−0.306	0.5	
	X1_6	−0.058	0.5	
	X1_7	0.362	0.5	
Capital (X2)	X2_1	0.398	0.5	0.535
	X2_2	0.451	0.5	
	X2_3	0.839	0.5	
	X2_4	0.996	0.5	
	X2_5	0.786	0.5	
Farmer Age (X3)	X3_1	0.644	0.5	0.512
	X3_2	0.659	0.5	
	X3_3	0.829	0.5	
Education (X4)	X4_1	1.002	0.5	0.639
	X4_2	0.905	0.5	
	X4_3	0.658	0.5	
	X4_4	0.548	0.5	
Farming Experience (X5)	X5_1	0.732	0.5	0.425
	X5_2	0.445	0.5	
	X5_3	0.736	0.5	
Human Resources (Y1)	Y1_1	0.918	0.5	0.393
	Y1_2	0.813	0.5	
	Y1_3	0.573	0.5	
	Y1_4	−0.248	0.5	
	Y1_5	0.263	0.5	
Effectiveness of Agricultural Extension (Y2)	Y2_1	0.671	0.5	0.210
	Y2_2	0.668	0.5	
	Y2_3	0.567	0.5	
	Y2_4	−0.043	0.5	
	Y2_5	0.074	0.5	
	Y2_6	0.179	0.5	

When viewed from the strength of the loading factor (Standardized Weights) on each variable, the X1_4 indicator has the highest contribution to the Technological Progress variable (X1) of 95.6%. Then, the Capital variable (X2) is dominated by the X2_4 indicator of 99.6%. Furthermore, the X3_3 indicator has the highest contribution to the Farmer Age variable (X3) at 82.9%. Then the Education variable (X4) is dominated by the X2_4 indicator of 90.5%. Then the X5_3 indicator has the highest contribution to the variable Age of Farming Experience (X5) at 73.6%. Furthermore, the Human Resources variable (Y1) is dominated by the Y1_1 indicator of 91.8.0%. Finally, the Agricultural Extension Effectiveness (Y2) variable is dominated by the Y2_1 indicator of 67.1%.

Validity can be seen through the loading factor and the Average Variance Extracted (AVE). An instrument is said to meet the validity test if it has an Average Variance Extracted (AVE) above 0.5. The results of the convergent validity test are presented in Table 15:

Based on Table 15, it can be seen that overall, the indicators on the variables of Technological Advance (X1), Farming Experience (X5), Human Resource (Y1), and Effectiveness of Agricultural Extension (Y2) are declared valid in measuring the variables because they have fewer AVE values of 0.5. Cronbach's alpha was used for reliability. This value reflects the reliability of all indicators in the model. The minimum value is 0.7. In addition to Cronbach's alpha, composite reliability values are also used, interpreted the same as Cronbach's alpha values (Figure 3).

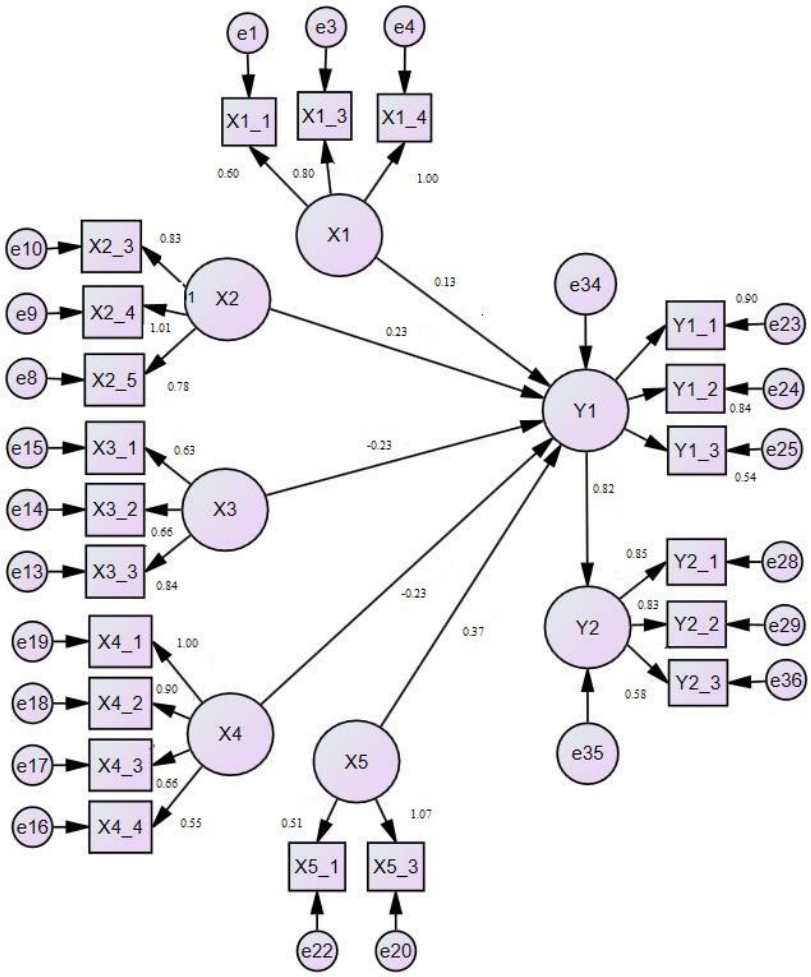

Figure 3. Path Diagram After Invalid Indicator Drop.

The validity of each indicator in measuring the latent variable is indicated by the size of the loading factor (Standardized Weights). An indicator is declared valid if the loading factor of an indicator is positive and is greater than 0.5. The results of the validity test and the loading factor, the Average Variance Extracted (AVE) value, are obtained, which is presented in Table 15.

2. Construct Reliability Test

The construct reliability test was carried out using the construct reliability (CR) technique. The test criteria state that the coefficient of construct reliability (CR) and Cronbach's alpha 0.6 means that it can be stated that the construct is reliable or the indicator is consistent in measuring the variables it measures.

4.2.2. SEM Model Evaluation

1. Model Fit Test

Testing the feasibility/fitness of the model (construct) is intended to determine whether the construct formed is appropriate (feasible). There are several test indices in SEM analysis, namely CMIN/DF, RMSEA, TLI, and CFI. The test criteria use CMIN/DF; if the CMIN/DF value is the cut-off value (2.00), then the construct formed is appropriate (feasible). The criteria using RMSEA state that if the RMSEA value is the cut-off value (0.08), then the construct formed is appropriate (feasible). The criteria using TLI and CFI state that if the goodness of fit value is the cut-off value (by 0.90), then the model formed is appropriate (feasible).

Based on Table 16, it can be seen that all indicators are valid. An indicator is valid if the loading factor is positive and greater than 0.5.

Table 16. Construct Validity Test After Drop Invalid Indicator.

Variable	Indicator	Loading Factor	Criteria	Description
Technology Advances (X1)	X1_1	0.600	0.5	Valid
	X1_3	0.805	0.5	Valid
	X1_4	0.999	0.5	Valid
Capital (X2)	X2_3	0.830	0.5	Valid
	X2_4	1.008	0.5	Valid
	X2_5	0.776	0.5	Valid
Farmer Age (X3)	X3_1	0.633	0.5	Valid
	X3_2	0.659	0.5	Valid
	X3_3	0.838	0.5	Valid
Education (X4)	X4_1	1.004	0.5	Valid
	X4_2	0.903	0.5	Valid
	X4_3	0.656	0.5	Valid
	X4_4	0.548	0.5	Valid
Farming Experience (X5)	X5_1	0.510	0.5	Valid
	X5_3	1.066	0.5	Valid
Human Resources (Y1)	Y1_1	0.900	0.5	Valid
	Y1_2	0.839	0.5	Valid
	Y1_3	0.544	0.5	Valid
Effectiveness of Agricultural Extension (Y2)	Y2_1	0.849	0.5	Valid
	Y2_2	0.835	0.5	Valid
	Y2_3	0.578	0.5	Valid

Based on Table 17, it can be seen that the AVE for all variables are valid because AVE > 0.5.

Table 17. Validity Test After Drop Invalid Indicator.

Variable	AVE	Description
Technology Advances (X1)	0.669	Valid
Capital (X2)	0.769	Valid
Farmer Age (X3)	0.512	Valid
Education (X4)	0.639	Valid
Farming Experience (X5)	0.698	Valid
Human Resources (Y1)	0.757	Valid
Effectiveness of Agricultural Extension (Y2)	0.709	Valid

Based on Table 18, it can be seen that the construct reliability and Cronbach's alpha values for all variables are more significant than 0.6. Thus, these variables are declared reliable based on the calculations of construct reliability and Cronbach's alpha.

Table 18. Reliability Test.

Variable	Construct Reability	Cronbach's Alpha	Description
Technology Advances (X1)	0.814	0.807	Reliable
Capital (X2)	0.854	0.884	Reliable
Farmer Age (X3)	0.791	0.729	Reliable
Education (X4)	0.872	0.782	Reliable
Farming Experience (X5)	0.700	0.704	Reliable
Human Resources (Y1)	0.829	0.681	Reliable
Effectiveness of Agricultural Extension (Y2)	0.804	0.776	Reliable

Based on Table 19, it can be seen that the four indications, namely CMIN/DF, RMSEA, TLI, and CFI, do not meet the criteria. Thus, the SEM model that has been formed is declared not feasible.

Table 19. Goodness of Fit Model.

Index	*Goodness of Fit*	*Cut Off Value*	Description
CMIN/DF	2.709	≤2.00	Poor of Fit
RMSEA	0.148	≤0.08	Poor of Fit
TLI	0.673	≥0.90	Poor of Fit
CFI	0.714	≥0.90	Poor of Fit

Because the model is not feasible, modifications to the covariance index are carried out to obtain a fit model. Basically, the structural equation modeling (SEM) method in AMOS is a covariance-based SEM (CB-SEM) which needs to be accommodated by the covariance element. For example, the following is a path diagram after modification of the index covariance model (Figures 4 and 5):

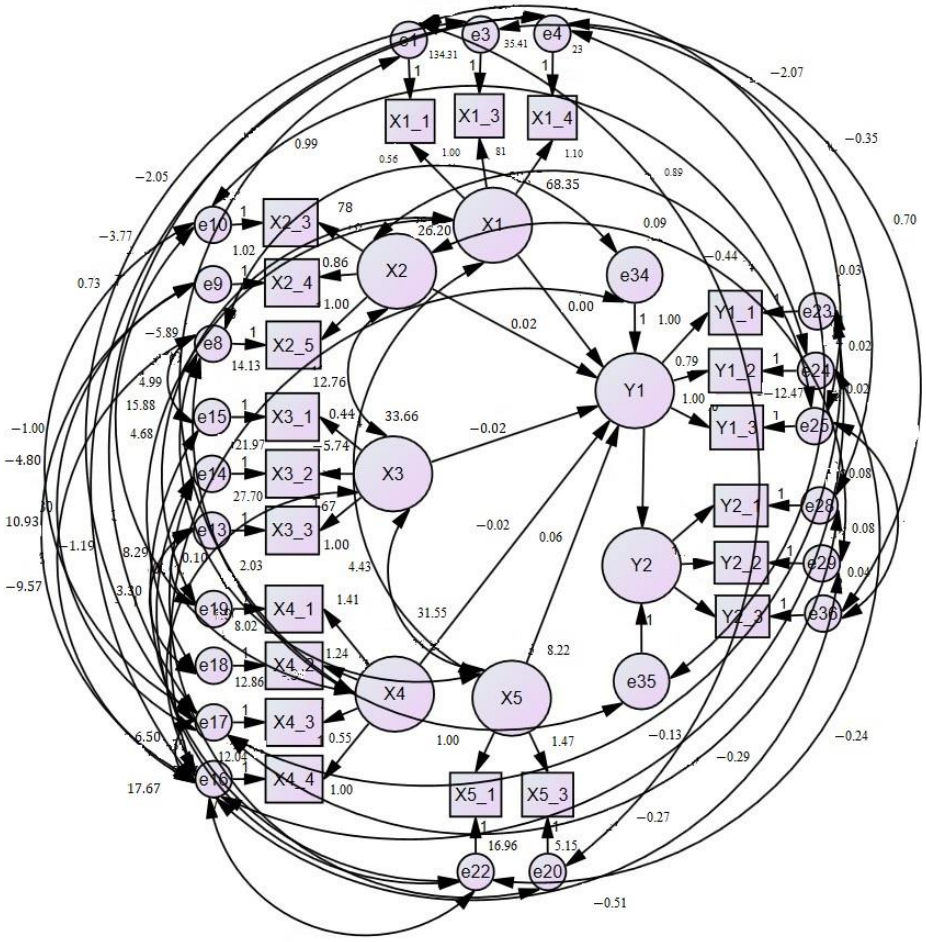

Figure 4. Path Diagram After Modifying the Covariance Index (Unstandardized).

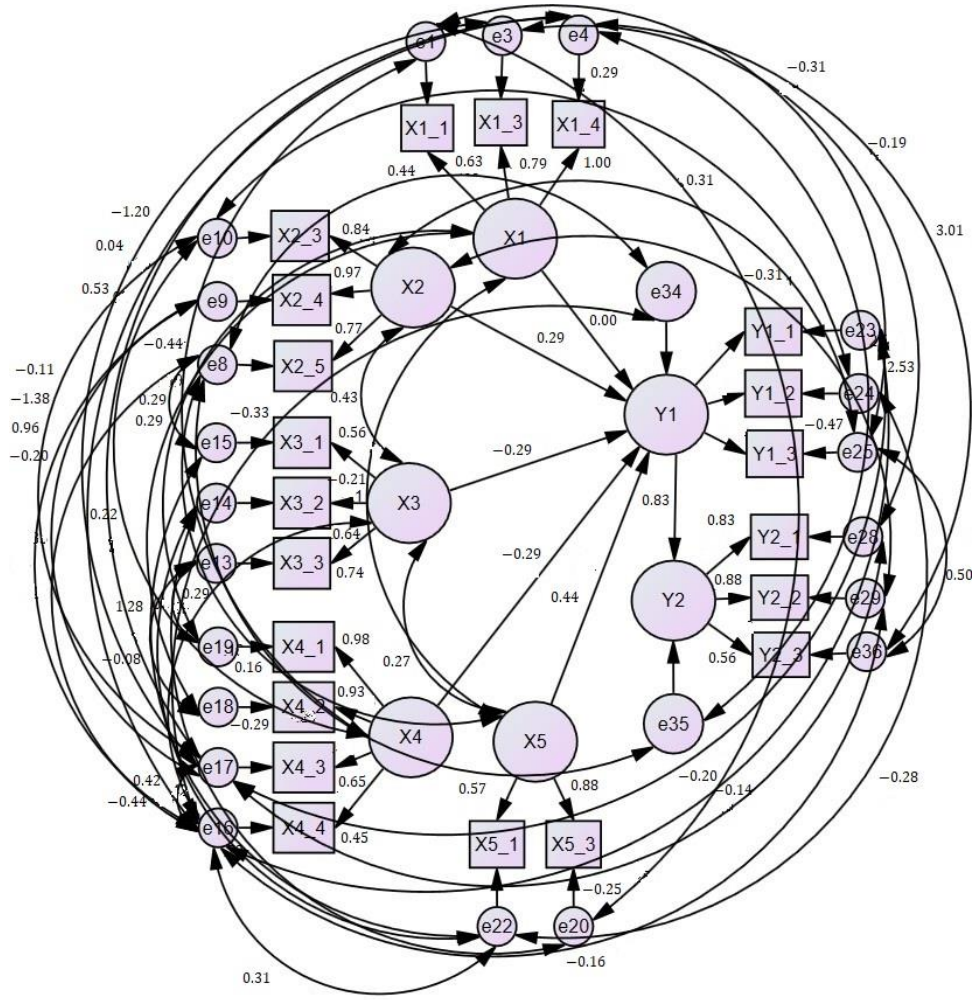

Figure 5. Path Diagram After Modification of Covariance Index (Standardized).

The results of the model feasibility test after modification of the covariance index have been summarized in Table 20. Based on the summary of the goodness of fit, it can be seen that the four indices, namely CMIN/DF, RMSEA, TLI, and CFI, all meet the criteria. Therefore, from the results of the index criteria, it can be concluded that the SEM path diagram that has been formed is declared suitable for use.

Table 20. Goodness of Fit Model (After Modification of the covariance).

Indeks	*Goodness of Fit*	*Cut Off Value*	Description
CMIN/DF	1.400	≤2.00	*Good of Fit*
RMSEA	0.061	≤0.08	*Good of Fit*
TLI	0.945	≥0.90	*Good of Fit*
CFI	0.963	≥0.90	*Good of Fit*

2. Model Hypothesis Test

a. Direct Effect Test

Hypothesis testing is intended to test whether exogenous variables have a direct effect on endogenous variables. The significance test can be known through the *p*-value. The test criteria state that if the CR statistic is >1.96 or if the *p*-value is <0.05, there is a significant effect of exogenous variables on endogenous variables. The analysis results can be seen in the summary in Table 20.

The following can be inferred from Table 21:

1. Testing the effect of Technological Progress (X1) on Human Resources (Y1) produces a CR statistic of 0.019 and a *p*-value of 0.985. The test results show that the *p*-value (0.985) > alpha 0.05, meaning no significant effect of technological progress on Human Resources.
2. The test of the effect of Capital (X2) on Human Resources (Y1) produces a *p*-value of 0.001. The test results show that the statistical *p*-value (0.001) < alpha 0.05, which means that there is a significant effect of Capital on Extension Issues. The positive coefficient of 0.289 indicates that Capital positively affects Human Resources. This means that the higher the Capital, the higher the Human Resources.
3. Testing the effect of Farmer Age (X3) on Human Resources (Y1) produces a CR statistic of −2389 with a *p*-value of 0.017. The test results show that the statistical *p*-value (0.017) < alpha 0.05, meaning that Farmer's Age has a significant effect on Human Resources. A negative coefficient of −0.287 indicates that Farmer Age harms Humans Resources. This means that the higher the Farmer's Age, the lower the Human Resources.
4. The effect of Education (X4) on the Human Resources (Y1) test produces a CR statistic of −3.908 with a *p*-value of 0.001. The test results show that the *p*-value (0.001) < alpha 0.05 means that Education has a significant effect on Human Resources. This means that the higher the Education, the higher the Human Resources.
5. Testing the effect of Farming Experience (X5) on Human Resources (Y1) resulted in a CR statistic of 4.467 with a *p*-value of 0.001. The test results show that the statistical *p*-value (0.001) < alpha 0.05 means that Farming Experience has a significant effect on Human Resources. A positive coefficient of 0.440 indicates that the Farming Experience positively affects Human Resources. This means that the better the Farming Experience, the better the Human Resources.
6. The test of the influence of Human Resources (Y1) on the Effectiveness of Agricultural Extension (Y2) resulted in a CR statistic of 9.027 and a *p*-value of 0.001. The test results show that the statistical *p*-value (0.001) < alpha 0.05, which means that Human Resources has a significant influence on the Effectiveness of Agricultural Extension. The positive coefficient of 0.828 indicates that Human Resources positively affect the Effectiveness of Agricultural Extension. This means that better Human Resources can increase the Effectiveness of Agricultural Extension.

Table 21. Hypothesis test.

Hypothesis	Track	Standardized Coefficient	SE	CR	*p*-Value	Description
H1	X1→Y1	0.001	0.003	0.019	0.985	Not significant
H2	X2→Y1	0.289	0.006	3.255	0.001	Significant
H3	X3→Y1	−0.287	0.008	−2.389	0.017	Significant
H4	X4→Y1	−0.294	0.005	−3.908	***	Significant
H5	X5→Y1	0.440	0.013	4.467	***	Significant
H6	Y1→Y2	0.828	0.114	9.027	***	Significant

Description: *** *p*-value < 0.001.

b. Indirect Effect Test

Hypothesis testing is intended to test whether exogenous variables have an indirect effect on endogenous variables through mediating variables (intervening). Mediation testing can be known through the Sobel test. The test criteria state that if the z statistic > z table (1.96) or *p*-value < alpha 0.05, it is stated that there is a significant indirect effect of exogenous variables on endogenous variables through mediating variables (intervening). The analysis results can be seen in the summary in Table 21.

Based on Table 22, it can be stated that the test of the effect of Capital (X2), Farmer's Age (X3), Education (X4), and Farming Experience (X5) on the Effectiveness of Agricultural Extension (Y2) through the mediation of Human Resources (Y1) produces a statistical

p-value < alpha 5% which means that there is an indirect effect of Capital Progress (X2), Farmer Age (X3), Education (X4), and Farming Experience (X5) on the Effectiveness of Agricultural Extension (Y2) through the mediation of Human Resources (Y1). In other words, the Human Resources variable (Y1) can mediate the effect of Capital (X2), Farmer Age (X3), Education (X4), and Farming Experience (X5) on the Effectiveness of Agricultural Extension (Y2).

Table 22. Hypothesis test.

Hypothesis	Track	Indirect Coefficient	Std. Error	*p*-Value	Description
H7	X1→Y1→Y2	0.001	0.002	0.739	Not Significant
H8	X2→Y1→Y2	0.239	0.033	0.000	Not Significant
H9	X3→Y1→Y2	−0.238	0.034	0.000	Not Significant
H10	X4→Y1→Y2	−0.243	0.034	0.000	Not Significant
H11	X5→Y1→Y2	0.364	0.051	0.000	Not Significant

While the test of the effect of Technological Progress (X1) on the Effectiveness of Agricultural Extension (Y2) through the mediation of Human Resources (Y1) resulted in a statistical *p*-value (0.985) > alpha 5%, which means that there is no indirect effect of Technological Progress (X1) on the Effectiveness of Agriculture Extension (Y2) through the mediation of Human Resources (Y1) or, in other words, the Human Resources variable (Y1) is not able to mediate the effect of Technological Progress (X1) on the Effectiveness of Agricultural Extension (Y2).

3. Convert Path Diagrams to Structural Equations

The conversion of path diagrams into structural equations is intended to find out how the shape of the influence between constructs is based on their mathematical equations. Based on the attachment, it can be seen that the mathematical models formed are as follows:

$$\textbf{Equality 1: } Y_1 = 0.001\ X_1 + 0.239\ X_2 - 0.2873\ X_3 - 0.294\ X_4 + 0.440\ X_5$$

$$\textbf{Equality 2: } Y_2 = 0.828\ Y_1$$

5. Conclusions

1. The factors that influence the effectiveness of agricultural extension in Baubau City, Southeast Sulawesi, are farming capital, farmer's age, education, farming experience, and human resources.
2. The influence of these factors on the effectiveness of agricultural extension in Baubau city is as follows: if farming capital is high, human resources can be increased. Moreover, the higher the farmers' age, the lower the need for human resources. It was additionally noted that higher education of farmers contributes to improvement in human resources, and the increased experience in farming corresponded to an increase in human resources. Hence, increasing human resources will increase the effectiveness of agricultural extension.
3. Extension issues and materials affect the effectiveness of agricultural extension in Baubau City, where the influence can be categorized as Good or Influential.
4. Farming capital is land area, labor, use of fertilizers, pesticides, agricultural tools, and machines. There is an influence of farming capital variables on the effectiveness of agricultural extension.

Human resources describe the knowledge possessed by education, training, experience, and information received. Activities that must be carried out by agricultural extension workers in the city of Baubau are optimizing socialization and training related to agricultural land, for example, making demonstration plots so that farmers can see directly and have no doubts about the theory provided. In addition, one way to achieve extension

effectiveness is to increase human resources (agricultural extension workers) as program implementers so that the programs that have been designed can be implemented. The lack of extension workers resulted in a significant workload for each extension agent because the extension area assisted by the extension worker was large, and the number of assisted farmer groups was significant. Currently, there are 44,890 agricultural extension workers. These agricultural extension workers serve 71,479 villages, so they still need as many as 26,589 agricultural extension workers (agricultural extension center Indonesia, 2022) [20]. Many agricultural extension workers can supervise the assistance funds given to farmers so that they are appropriately managed to realize farmer welfare, distribute farmers' knowledge about the latest agricultural technologies, and develop rice farming. For example, they help to provide production facilities, distribute fertilizer and seed aid, and provide cooperative institutions to assist farmers in procuring farming capital. In addition, agricultural extension agents have roles as facilitators, communicators, motivators, and consultants. Indonesian Government Regulation no. 16 of 2006 concerning the Agricultural Extension System, one of the critical points in this law is the need to build extension institutions in the regions at the provincial and district/city levels.

Age affects productivity level, making decisions, and receiving information. The dominant number of respondents is 46–55 years old. This shows that the productive age in this study is in the age range of 46–55 years. At a productive age, it will be easier to get new ideas and quickly understand the use of technology. Information obtained by farmers, especially from agricultural extension workers, will increase their paddy rice production. This follows the research results (Hasyim, 2006) [17] that those who work at productive age will be better and maximal than non-productive age.

Education is influential in taking action in making programs for agricultural development. The low level of education in this study indicates that the quality of human resources needs to be improved in efforts to develop farming performance. Improving the skills and knowledge of farming will encourage the achievement of planned production targets. According to (Lubis, 2000) [18], having a high level of education will be relatively faster in implementing technology and innovation adoption; having low education usually makes it challenging to implement innovation adoption quickly.

The indicators included in the Technological Progress variable are the use of transplanters, the use of indo combine harvesters, the use of KATAM (planting season prediction), the use of KATAM (fertilizer dose), the use of drones (irrigation sensors/measuring soil pH), the use of expert system applications, and the use of social media. The average variable of Technological Progress is 24.91, with an achievement level of 64.53% in the less good category. Farmers should optimize information technology, such as using the internet to find the latest information. Advances in technology play a role in supporting the availability of relevant and timely agricultural information. Information on the results of research and technological innovations in agriculture helps efforts to increase the production of agricultural commodities. According to research results (Prayoga, K. 2017) [21], the use of technology is considered less optimized by the Indonesian Ministry of Agriculture. Extension activities that utilize social media must continue to be optimized because the number of users continues to increase.

5. Matters related to extension include the number of assisted farmers, the distance to extension locations, the amount of agricultural extension work time, extension media, methods, frequency, materials, and the instructor's experience. Extension media has the most significant contribution to the problem variables of extension agents. Through extension media, it can attract farmers to attend training. Agricultural extension agents use various media that are adjusted to the farmer's age—then, followed by indicators of instructor experience, frequency of extension, amount of working time of agricultural extension workers, extension methods, and extension materials. Extension material is everything that extension agents propose to farmers, including the suitability of the material with the needs and benefits. Based on the assessment of the extension workers in the field, it was assessed that the absorption of the material

and the most suitable application were in fertilization, harvesting, and post-harvest materials. This is followed by good planting time, nurseries, planting, nursery, and maintenance indicators. Agriculture is a critical sector in national development. In national development, it is necessary to support human resources, who have the capacity, who can produce solutions to answer the challenges. Therefore, it is necessary to carry out an agricultural extension to develop agriculture. Agricultural extension is also one of the efforts to produce quality human resources. Agricultural extension is an empowerment effort or an effort to motivate and change the behavior of farmers and their families so that they have the will and can solve the problems they face in doing their farming. Therefore the role of extension is crucial and becomes a strategic matter in national development.

The Ministry of Agriculture is targeting Indonesia to become a world food barn by 2045. To achieve this mission, the Ministry of Agriculture places farmers as the main actors in agricultural development. Therefore, attention is needed from farmers through agricultural extension workers. In general, the knowledge farmers have to lack in renewal, and the existence of agricultural extension can help agricultural development.

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