

Institutional Performance and Utilization of Farm Machinery to Enhance Productivity and Income of Rice Farmers

Teguh Endaryanto¹, Sandi Asmara², Tanto Pratondo Utomo³, Amanda Putra Seta^{1,✉}, Firdasari¹

¹ Agribusiness Department, Faculty of Agriculture, Lampung University, Bandar Lampung, INDONESIA.

² Agricultural and Biological Engineering Department, Faculty of Agriculture, Lampung University, Bandar Lampung, INDONESIA.

³ Agroindustrial Technology Department, Faculty of Agriculture, Lampung University, Bandar Lampung, INDONESIA.

Article History:

Received : 13 November 2024

Revised : 31 December 2024

Accepted : 19 January 2025

Keywords:

*Alsintan,
Institutional,
Optimization.*

Corresponding Author:

✉ amanda.putra@fp.unila.ac.id
(Amanda Putra Seta)

ABSTRACT

The utilization of technology in the agricultural industry is significantly growing recently. This is mostly due to its ability to enhance labor and land productivity, while simultaneously reducing production costs. The objective of this study is to examine the institutional performance and utilization of farm machinery (alsintan) by rice farmers, and to investigate the correlation between institutional performance and alsintan usage on the productivity and income of rice farmers. The study was carried out in two villages in the Central Lampung Regency, namely Rengas Village in Bekri District, and Trimurjo Village in Trimurjo District. Rice farmers in both villages actively utilized alsintan operated under the alsintan service unit (UPJA). The study findings indicate a strong and meaningful correlation between institutional performance and the utilization of alsintan with productivity and income level of farmers. Alsintan technology directly impacted productivity and revenue with coefficients of 0.63 and 0.60, with confidence levels of 99.9% and 99.7%, respectively. Institutional performance indirectly affected them with a coefficient of 0.30 and a confidence level of 99.99%. The integration of enhancing institutional performance with the optimization of alsintan technology can foster the enhancement of other factors, such as human resource performance, group member involvement, and external environmental support.

1. INTRODUCTION

In today's agricultural development, institutions and technology have become interdependent and mutually reinforcing. These two concepts are tightly interconnected, particularly when it comes to advancements in agricultural production. According to Soesilowati *et al.* (2020), institutional performance plays a significant role in promoting technological advancements among farmers. Furthermore, the establishment of farmer institutions is an essential requirement for the long-term integration of technical advancements in agricultural development (Sihombing, 2023).

The enhancement of farmer institutions is being accelerated as a new paradigm of development, originating from, created by, and intended for farmers, is emerging. The existing agricultural institution should prioritize enhancing the economic conditions of farmers (Effendy, 2020; Sariati & Hayanti, 2023). Up until now, farmer institutions have mostly focused on social and administrative tasks. Farmers who lack familiarity with administrative tasks perceive participation in farmer associations as an onerous responsibility. Furthermore, farmers are often burdened with the costs associated with excessive social activities. Pagala *et al.* (2023), found that farmer groups are more actively engaged in social administrative activities compared to commercial operations. Hence, it is imperative to undertake institutional restructuring in order to ensure economic advantages for farmers.

The industrial revolution 4.0 promotes technological development in various sectors, including agricultural, in line with ongoing institutional changes. Over the past few years, there has been a significant surge in the adoption of technology in the agricultural industry, including fertilizers, and chemicals, agricultural machinery (called as “Alsintan”), and the latest addition of artificial intelligence (AI) and drones. The growing utilization of technology in the agriculture industry is undeniably justified. The primary factor is that the utilization of technology in the agricultural fields has a significant influence on augmenting labor and land productivity, while concurrently diminishing production costs (Rusydi & Rusli, 2022). Agricultural tools and machinery technology is one area of technology that is still developing in Indonesia, both in terms of its applications and its end products. The utilization of agricultural implements and Alsintan in Indonesia is steadily expanding and advancing in tandem with technological advancements. Various types of Alsintan are currently being used by farmers in their cultivation activities, particularly for food crop commodities. Farmers are familiar with various Alsintan for pre-harvest and post-harvest activities. The often utilized pre-harvest Alsintan are tractors (2 and 4 wheel), transplanters, water pumps, and sprayer. Commonly utilized post-harvest equipment includes combine harvesters, power trashers, and dryers.

Lampung Province is now experiencing significant institutional and technological upheaval. As the seventh largest rice producer in Indonesia, Lampung Province has utilized Alsintan as a means of supporting farmer agriculture efforts. From 2017 to 2021, a total of 3,180 hand tractors, 433 four-wheeled tractors, 4,216 water pumps, and various other types of equipment have been provided to all agricultural regions in Lampung Province. Furthermore, there are several post-harvest implements available, including combine harvesters, power threshers, and dryers. Every form of Alsintan support is allocated exclusively to farmer groups that have been officially registered with the Indonesian Ministry of Agriculture. Central Lampung Regency has received several sorts of Alsintan aid from 2018 to 2023, which has been funded by the State Budget, Provincial Budget, and Regency Budget. The management of Alsintan aid is carried out through the collaboration of farmer collectives or associations. The manager responsible for Alsintan at the village level is referred to as the Alsintan Service Management Unit (UPJA), which works in coordination with the Alsintan brigade at the district level. Aside from the publicly funded Alsintan, there are also privately owned or commercial Alsintan that are operational in every sub-district within the Central Lampung Regency. Farmers are becoming more and more acquainted with agricultural mechanization. Efficient management of Alsintan by farmer collectives can directly and indirectly benefit farmers. Hence, the institutional function of farmer organization is crucial, as they serve not only as beneficiaries of aid but also as administrators of agricultural machinery support.

Additionally linked to the employment of Alsintan technology are institutional issues. The primary issue faced by farmer institutions is the inadequate replenishment of farmer squads, which refers to the farm laborers responsible for planting and harvesting. Furthermore, a significant portion of the old individuals among the farming group also provide a challenge. This leads to a rise in the need for Alsintan and equipment, both before and after the harvest. Conversely, the presence of Alsintan in the village is extremely restricted. Farmers frequently confront the need to queue for the use of Alsintan, especially during the planting or harvesting season. Delaying the act of planting and harvesting crops has the capacity to affect the efficiency and financial earnings of farmers (Rusydi & Rusli, 2022). This phenomenon is rooted in the delay in planting, which results in farmers being unable to plant their crops at the same time. Consequently, this situation has significant repercussions for the escalation of pest attacks. Furthermore, postponing the harvest can result in an increase in crop loss. Furthermore, it should be noted that many types of agricultural machinery may not be readily accessible within the hamlet. The availability of some Alsintan, such as rice transplanters and combine harvesters, is now insufficient despite the urgent demand for their use.

In Lampung Province, there are various critical issues with institutional frailty and the suboptimal utilization of Alsintan. The lack of independence of farmer institutions and UPJA results in the absence of economic benefits for farmers. Conversely, the insufficient and unstrategic utilization of agricultural technology, coupled with the limited skills and knowledge of management, results in a minimal impact on farmers (Fitriyana *et al.*, 2023).

Consequently, it is highly pertinent for this study to be conducted in Lampung Province to investigate the potential for institutional advancement and enhanced utilization of Alsintan. This research offers novel insights and methodologies for prospective agricultural advancement. Numerous prior research, like Teguh *et al.* (2022), Ikuemonisan *et al.* (2020), Zakaria *et al.* (2019), among others, have failed to elucidate the direct and indirect effects of institutions and the utilization of Alsintan technology on productivity and revenue.

Furthermore, prior research has predominantly focused on institutional strengthening alone. The contemporary application of Alsintan technology substantially alters and influences the socio-economic conditions of farmers. Evidence in the domain indicates that the application of Alsintan demonstrates a relatively swift advancement. Consequently, a more thorough and extensive investigation is required about the role and institutional relationship of farmers, as well as the impact of Alsintan on farmers' productivity and revenue.

This study aims to examine the institutional performance and utilization of Alsintan by rice farmers, and explore the correlation between institutional performance and Alsintan usage with the productivity and income of rice farmers in Central Lampung Regency. One of the anticipated advantages of this research is that it will advance the scientific understanding of the connection between the productivity and income of farmers and the effectiveness of Alsintan and institutional performance. Furthermore, it is essential to furnish knowledge and insights to farmers and other stakeholders, emphasising that the optimization of agricultural machinery and the fortification of institutions must occur concurrently to enhance the efficiency and efficacy of farming.

2. MATERIALS AND METHODS

The research was conducted in July 2024 in Trimurjo Village (Trimurjo District), and Rengas Village (Bekri District), Central Lampung Regency (Figure 1). The locations were deliberately selected due to the presence of UPJA and farmer groups actively involved in the management of Alsintan. Furthermore, the two sub-districts rank as the second and third most significant rice producers in Central Lampung Regency. The participants in the study consisted of 3 managers from the district-level Alsintan brigade, 2 managers from UPJA, and 30 farmers evenly distributed between the two villages. The sampled farmers were rice farmers who utilized Alsintan for both pre and post-harvest activities. A random selection method called simple random sampling was employed to select farmers who utilized Alsintan. The utilization of the SMART PLS program is particularly pertinent given this sample size, as it effectively facilitates statistical analysis with a little number of samples while ensuring validity and reliability are unquestionable.

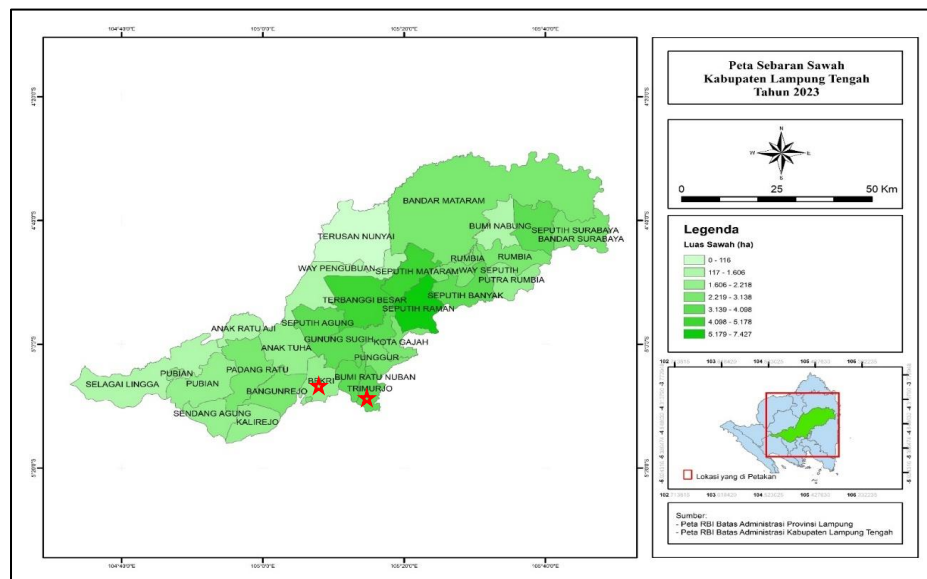


Figure 1. Map of rice fields and research locations (★)

Qualitative descriptive analysis was used to examine the usage of Alsintan and the performance of the institutions. An assessment of the institutional performance of rice farmers was conducted to obtain a comprehensive overview of the status of rice farmer organizations. The analysis of institutional performance involves the identification of multiple indicators. The indicators encompass the clarity of objectives set by the farmer group, the effectiveness of their management and leadership, their ability to operate independently, the unity and coherence of their members, and their

interactions with external entities. The investigation of the utilization of Alsintan is conducted to ascertain the overall perspective regarding its usage. The indicators examined include user characteristics, the type of Alsintan utilized, and the source or origin of Alsintan.

The study examined the correlation between institutional performance and the utilization of Alsintan with farmers' productivity and income through the application of the SEM (Structural Equation Model) framework. SEM analysis has numerous advantages compared to alternative methods. SEM analysis is applicable to a restricted number of samples. Furthermore, SEM can assess both direct and indirect effects. The Structural Equation Model can also offer advice on the strategic priorities to select in problem-solving. Consequently, SEM analysis can effectively address the issue presented in this study.

In SEM analysis, various statistical computations, including Cronbach α , rho A, Composite Reliability, and AVE, were performed to assess the validity and reliability of the data. Cronbach's Alpha (α) quantifies the internal consistency of a collection of indications or elements constituting a singular concept. Rho A provides more reliable measures than Cronbach's Alpha due to its less dependence on the number of items. Composite Reliability evaluates the overall reliability of a construct, factoring in the contribution of each indicator to that construct. Average Variance Extracted (AVE) assesses the validity of convergence, indicating the extent to which indicators accurately represent the concept being measured (Juliandi, 2018).

Table 1. Institutional SEM variables and indicators and Alsintan usage

Variable	Indicator
Human Resource Performance (KS)	Farmer Age (KS1), Education (KS2), Farming Experience (KS3), Farmer Motivation (KS4), Land Area (KS5), Other Businesses (KS6), Activeness in participating in counseling (KS7), and Activeness in providing mandatory contributions (KS8)
Group Membership Participation (PKK)	Activeness in participating in meetings (PKK1), Activeness in providing input (PKK2), Involvement in the management of group business units (PKK3), Involvement in group business activities (as users/consumers) (PKK4)
External Environment Support (DLE) (Haekal <i>et al.</i> , 2021)	Frequency of Counseling Assistance by Extension Workers (DLE1), frequency of Government Assistance (DLE2), Cooperation with the Private Sector (DLE3), and Cooperation with research institutions (DLE4).
Institutional Performance (KK)	Clarity of objectives (KK1), suitability of objectives with the needs of members (KK2), ability to obtain, manage, maintain, and deploy information, labor, capital, and materials (KK3), ability to manage conflicts (KK4), Implementation of group leadership functions (KK5), clear division of duties and authority (KK6), Commitment of members (KK7), Availability of independent funding sources (KK8), availability of physical facilities to support institutions (offices, etc.) (KK9), Sentiment, awareness, and cohesiveness of members (KK10), Cooperation with outside/other parties (KK11), and Communication patterns between members (KK12).
Use of Alsintan Technology (PTA) (Bukchin & Kerret, 2020)	The use of <i>alsintan</i> in land cultivation (PTA1), rice planting (PTA2), water pumps (PTA3), rice weeding (PTA4), HPT control (PTA5), harvesting (PTA6), and drying (PTA7)
Productivity (PV)	Quantity (PV1), Quality (PV2)
Farm Income Level (TPU)	Price (TPU1), Revenue (TPU2), Farming Costs (TPU3), and R/C (TPU4).

This approach enables the analysis of the link between two or more components, with direct or indirect interaction. Table 1 provides a comprehensive overview of the variables and indicators used in the institutional model and the utilization of Alsintan. The benefits of Alsintan in boosting income and productivity were represented by a structural model involving 3 exogenous (independent) variables, 2 endogenous (dependent) variables, and 2 intermediary variables. The 3 exogenous variables were human resource performance (X1) (Nurwiana, 2019), group membership involvement (X2), and external environmental support (X3). The two intermediary variables included institutional performance (Z1) and the utilization of Alsintan (Z2). The two dependent variables were productivity (Y1) and Farming Income Level (Y2). Additionally, a tester variable was employed to determine if the independent and intermediary variables had an impact on the dependent variables. The initial step in SEM analysis involved conducting tests to assess the validity, reliability, and multicollinearity of the indicators. Subsequently, a hypothesis test and path

analysis were conducted to examine both the direct and indirect effects. Subsequently, analysis of the findings and the formulation of recommendations were conducted.

3. RESULTS AND DISCUSSION

3.1. Institutional Performance of Rice Farmers

There have been numerous changes to the institutional performance of rice farmers in Central Lampung. The study assessed institutional functioning by gauging farmers' impression of various factors. The indicators encompass the following aspects: the explicitness of the objectives of farmer organizations, the effectiveness of their management and leadership, their autonomy, the unity of their members, and their interactions with external entities. The clarity of purpose is determined by the degree to which the objectives of the farmer organization are aligned with the needs of the farmers. Management and leadership indicators are evaluated by considering the management of human resources and assets, disputes, and the allocation of duties among managers. The state of the company held by the Alsintan and the availability of physical support facilities like offices are used to calculate the independence indicator. Cohesion is assessed based on the level of commitment, cohesion, and communication patterns exhibited by group members. The assessment of relationships with external parties is determined by the frequency of collaboration between the group and these partners. Syofian *et al.* (2020) and Widiyanti *et al.* (2023), elucidated that social capital serves as a valuable asset for farmers when they collaborate in groups, enabling them to gather pertinent knowledge pertaining to their agricultural endeavors. Thus, certain indices mentioned earlier are clear indications of the social capital present within farmer communities. The way farmers see the effectiveness of farmer groups is presented in Table 2.

Table 2. Farmers' perception of the performance of farmer groups in Central Lampung Regency

Indicator	Perception of Farmers as Members of Farmer Groups (%)				
	Worse	Bad	Not Bad	Good	Best
The Clarity of groups objectives (Vision, Mission, Program)	7	33	35	25	0
Management and leadership	7	12	53	28	0
Member cohesiveness	7	11	53	29	1
Independence	13	15	45	27	0
Relations with external parties	7	20	60	13	0

Most farmers believe that institutional performance, in terms of management and leadership, independence, coherence, and relations with other parties, is satisfactory and positive. However, when it comes to the clarity of goals, specifically the vision, mission, and program, 40% of farmers believe that it is still inadequate. Rice farmers in Central Lampung Regency exhibit a relatively high level of innovation compared to farmers cultivating other commodities and rice farmers in neighboring districts. The rice growers' association is highly engaged. The frequency of group gatherings, mutual cooperation, and the execution of other group objectives is highly satisfactory. Both villages have farmer organizations that operate businesses, including the management of Alsintan services, in order to maintain their independence. Despite suboptimal profitability, the farmer collective has a self-sustaining income. Furthermore, there is a significant level of collaboration with external entities from each of these groupings, particularly with the district agriculture office. Nevertheless, there has not been any establishment of collaboration with any external entities. Thus, when it comes to autonomy and interactions with external entities, there is still a significant prevalence of negative perceptions, namely at a rate of 27-28%. Furthermore, there is a scarcity of farmers who excel in every criterion. Merely 1% of farmers evaluated it favorably in terms of cohesiveness. This note holds significant importance for both the management and members of the farming group. The current farmer institutions lack sufficient strength, resulting in minimal benefits. Hence, there is a need for further enhancement in the functioning of institutions, particularly in terms of goal clarity, autonomy, and collaborative associations with external stakeholders.

3.2. The Utilization of *Alsintan*

Presently, farmers have the capacity to harvest only twice a year. The mean land area per farmer in Central Lampung Regency is about 0.58 hectares. On average, each farmer is only able to obtain approximately IDR6,000,000 per

harvest season. The utilization of *alsintan* by rice farmers has become commonplace and widely accepted. Farmers started utilizing *alsintan* as a means to enhance their production process in terms of land cultivation, irrigation, and harvesting.

The utilization of farmers' *alsintan* in Central Lampung area is categorised into two types: pre-harvest and post-harvest *alsintan*. The pre-harvest *alsintan* commonly utilized by farmers includes 2-Wheel Tractors (TR2) and 4-Wheel Tractors (TR4). One often utilized post-harvest *alsintan* is the combine harvester. All farmers have benefited *alsintan* TR 4 and TR 2 for soil cultivation. There is a scarcity of farmers that employ cows or buffaloes for agricultural purposes. Rice transplanters (RTs) have not been available for rent in the communities where the research was done, despite their use in certain rice planting areas. Regarding the process of harvesting, a significant majority of farmers, specifically 77%, have employed the use of combine harvesters. The decrease in the number of farmer squads has prompted farmers to transition from manual labor to utilizing combine harvesters. The utilization of alternative agricultural machinery, such as irrigation pumps and post-harvest drying equipment, is exceedingly uncommon. The rice fields in the two villages in the sub-district are rainfed. Water pumps are infrequently used by farmers to retrieve water from streams. Figure 2 illustrates that the utilization of agricultural technology by farmers has been notably intense, particularly in field preparation and harvesting tasks. It is also show the utilization of *alsintan*, which includes 2-wheel tractors, 4-wheel tractors, and combine harvesters.

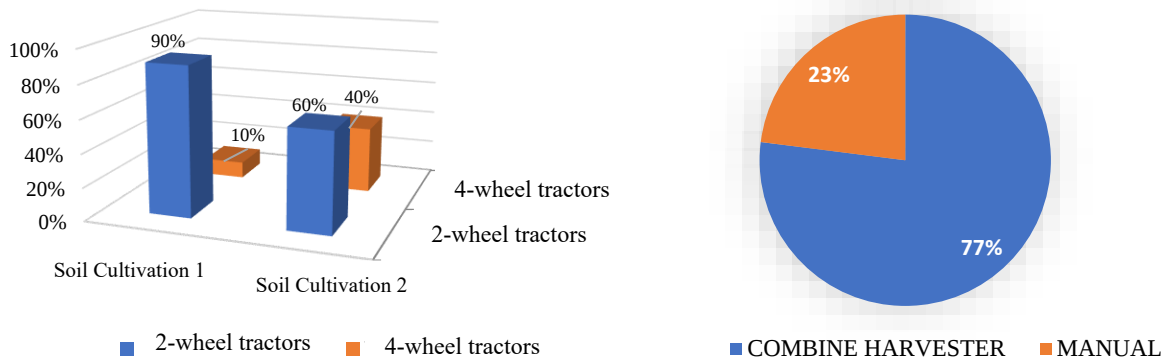


Figure 2. The use of 2-wheel tractors, 4-wheel tractors, and combine harvesters by farmers in Central Lampung Regency

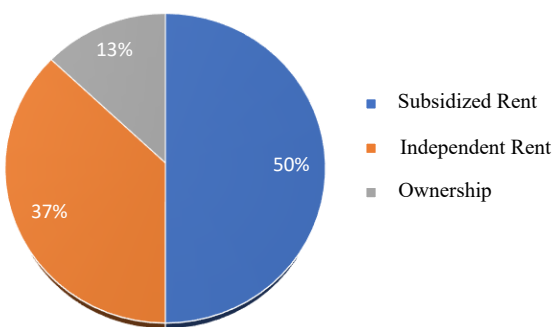


Figure 3. Source/origin of *Alsintan* rental for cultivation 1&2

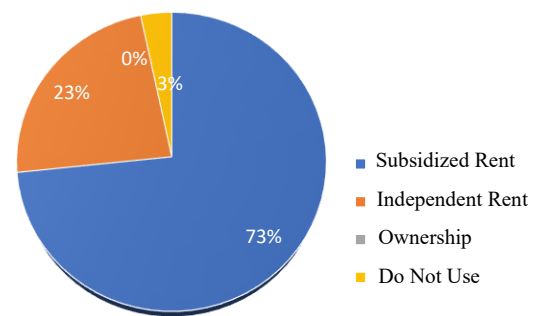


Figure 4. Sources/places of *Alsintan* rental for harvesting

Figure 3 and 4 represented that Most farmers hire combine and pre-harvest *alsintan* equipment from UPJA. Farmers find it more convenient to lease *ALSINTAN* owned by UPJA rather than privately owned ones. The benefit of farmers renting at UPJA is that they are not need to carry *alsintan* from outside the village. Additionally, UPJA's *alsintan* operators also provide marketing services, making it convenient for farmers to use these services. However, despite the limited equipment owned by UPJA, farmers are willing to form a line and wait for the schedule provided

by the UPJA operator. This indicates that farmers have had rather good access to *alsintan*. Farmers can readily obtain *alsintan* services through rentals from UPJA, private lessors, or other agents. The source or origin of *alsintan* rental can be observed in Figures 3 and 4, providing a comprehensive depiction.

3.3. Correlation of Institutional Performance and utilization of Alsintan with Production and Income

To ascertain the degree of validity of the model, a validity and reliability test was conducted prior to estimating the Path analysis results. The validity and reliability tests include the construct reliability and validity test, discriminant validity, and collinearity statistic. Once the reliability and validity of the structural model have been tested, it is represented in Figure 5.

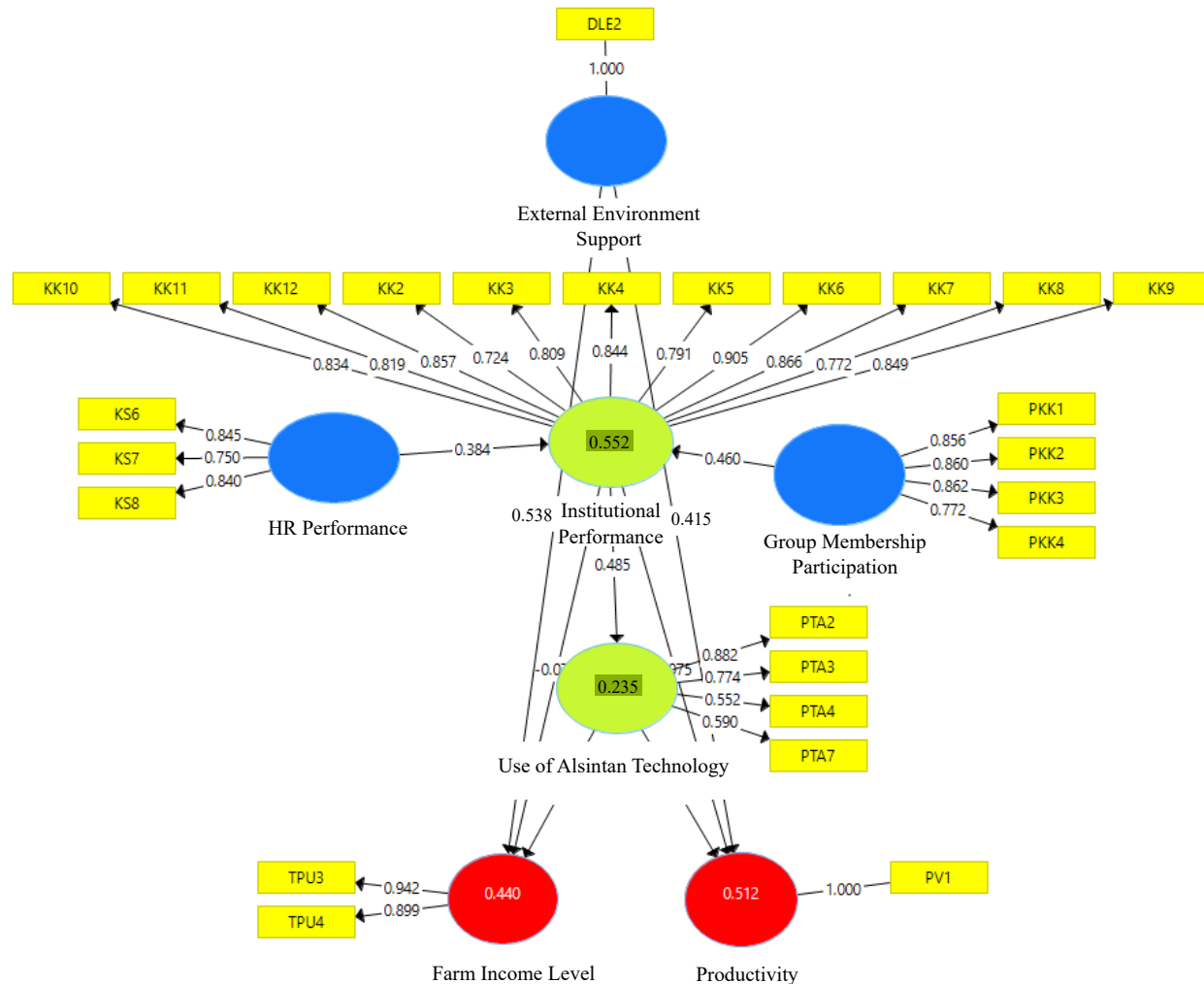


Figure 5. Test of validity and reliability of institutional model and use of Alsintan in Central Lampung Regency

According to the validity test results, multiple variables were deemed invalid. This may arise from various factors, including biased data collection, strong correlations across variables, variables misaligned with the research strategy, or data that inadequately elucidates the variation of the indicator. Invalid variables include Farmer Age (KS1), Education (KS2), Farming Experience (KS3), Farmer Motivation (KS4), Land Area (KS5), Frequency of Counselling Assistance by Extension Workers (DLE1), Cooperation with the Private Sector (DLE3), Cooperation with Research Institutions (DLE4), Clarity of Objectives (KK1), Use of *Alsintan* in Land Cultivation (PTA1), HPT Control (PTA5), Harvesting (PTA6), Quality (PV2), Price (TPU1), and Revenue (TPU2).

The validity test revealed that Other Businesses (KS6), Activeness in participating in counselling (KS7), and Activeness in delivering obligatory contributions (KS8) are indicators of legitimate HR performance variables. The variable of group participation can be measured by numerous reliable indicators, such as the level of engagement in meetings (PKK1), the level of contribution in providing input (PKK2), the level of involvement in managing group business units (PKK3), and the level of involvement in group business operations as users or consumers (PKK4). An indicator of external environmental support that influences how frequently the government provides assistance (DLE2). The institutional performance indicators that impact the alignment of goals with member needs (KK2) include the capacity to acquire, handle, preserve, and utilize information, labour, capital, and materials (KK3), the ability to manage conflicts (KK4), the execution of group leadership functions (KK5), the establishment of clear division of responsibilities and authority (KK6), the presence of member dedication (KK7), and the presence of independent funding sources (KK8). The presence of physical infrastructure to facilitate the functioning of institutions (such as offices, etc.) (KK9), the emotional tone, consciousness, and unity among members (KK10), collaboration with external or other entities (KK11), and the manner in which members communicate with one other (KK12). The acceptable indicators for the application of *alsintan* technology encompass its utilization in several stages of rice cultivation, such as PTA2 for rice planting, PTA3 for water pumping, PTA4 for rice harvesting, and PTA7 for drying. When it comes to measuring productivity, a reliable indicator is the production level (PV1), whereas for assessing income, we look at negative indicators such as farming costs (TPU3) and R/C (TPU4).

Four statistical tests were performed to determine the level of validity and reliability: discriminant validity, construct reliability and validity, and collinearity. The results of the reliability and validity test indicate that Cronbach's Alpha (CA), rho A, Composite Reliability, and Average Variance Extracted (AVE) all exceeded the thresholds of 0.7 and 0.5, respectively. This indicates that the model has satisfied the necessary standards of validity and reliability to be utilized as a measurement for path analysis. The Rho A test serves the same purpose as the Cronbach alpha test, namely assessing data reliability; however, the Rho A test offers a higher degree of reliability and confidence than Cronbach alpha. Table 3 displays the specific results for Cronbach alpha, Rho A, Composite Reliability, and Average Variance Extracted (AVE).

Table 3. The value of Cronbach's Alpha, Composite Reliability, rho A, dan Average Variance Extracted (AVE) on Model

	Cronbach Alpha	Rho_A	Composite Reliability	Average Variance Extracted (AVE)
External Environment Support (DLE)	1.000	1.000	1.000	1.000
Institutional Performance (KK)	0.953	0.961	0.959	0.682
HR Performance (HR)	0.748	0.776	0.854	0.661
Group Membership Participation (PKK)	0.860	0.885	0.904	0.703
Use of Alsintan Technology (PTA)	0.714	0.786	0.799	0.508
Productivity (PV)	1.000	1.000	1.000	1.000
Farm Income Level (TPU)	0.823	0.864	0.917	0.847

Furthermore, the discriminant validity indicates that the strength of the association with the variable in question surpasses the strength of its association with other variables. This demonstrates that the model's validity is strong and satisfactory. The Collinearity Statistic test is employed to assess multicollinearity. The purpose of this multicollinearity test is to determine if there is a strong or perfect correlation between the independent variables in the model. The results of the multicollinearity test indicate that there is no collinearity among the variables in the constructed model. The magnitude of the collinearity value between variables is recognized as being less than 3,000. Following the completion of validity, reliability, and multicollinearity tests, which yielded valid and satisfactory findings for the model, a route analysis test was conducted to examine the link between variables. Table 4 provides a comprehensive overview of the detailed outcomes that the direct effect study on the structural model indicates several findings:

1. There is a positive and significant impact of Direct External Environmental Support on Productivity (with a positive correlation (Original Sample Value = 0.415) and p -alue < 0.05).
2. The study found that receiving direct external environmental support has a positive and statistically significant impact on the income level of farming. The effect is significant at a p -value of less than 0.05.

Table 4. Results of direct effect analysis on institutional structural model and use of *alsintan* in Central Lampung Regency

Correlation between variables	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	t-Statistic (O/STDEV)	p-value
External Environment Support → Productivity	0.415	0.394	0.157	2.651	0.008
External Environmental Support → Farm Income Level	0.538	0.515	0.154	3.503	0.001
Institutional Performance → Use of Alsintan Technology	0.485	0.514	0.089	5.419	0.000
Institutional Performance → Productivity	0.075	0.076	0.181	0.413	0.680
Institutional Performance → Farm Income Level	-0.071	-0.060	0.283	0.250	0.802
HR Performance → Institutional Performance	0.384	0.412	0.132	2.911	0.004
Group Membership Participation → Institutional Performance	0.460	0.441	0.149	3.089	0.002
Use of <i>Alsintan</i> Technology → Productivity	0.630	0.634	0.161	3.922	0.000
Use of <i>Alsintan</i> Technology → the Income Level	0.606	0.599	0.205	2.951	0.003

- There is a positive and significant impact of Direct External Environmental Support on Productivity (with a positive correlation (Original Sample Value = 0.415) and p -value < 0.05).
- The study found that receiving direct external environmental support has a positive and statistically significant impact on the income level of farming. The effect is significant at a p -value of less than 0.05.
- The study found that institutional performance has a strong and statistically significant positive impact on the adoption of Alsintan technology, with a coefficient of +1 and a p -value of less than 0.05.
- The study found that institutional performance does not have a statistically significant impact on productivity, as indicated by a p -value greater than 0.05.
- The study found that there is no significant correlation between institutional performance and farming income level, as indicated by a p -value greater than 0.05.
- The study found that Human Resources Performance has a direct and statistically significant positive effect on Institutional Performance, with an observed coefficient of +1 and a p -value of < 0.05.
- Direct group membership participation has a positive and statistically significant impact on institutional performance (with a positive correlation (Original Sample Value = 0.460) and p -value < 0.05).
- The utilization of Alsintan technology has a direct and substantial impact on productivity, with a positive correlation (Original Sample Value = 0.630) and a statistically significant result (p -value < 0.05).
- The utilization of Alsintan technology has a direct and significant impact on the farmer income level, with a positive correlation (Original Sample Value = 0.606) and a statistically significant result (p -value < 0.05).

There are considerable disparities in farmers' production and income when comparing the institutional relationship and the utilization of Alsintan technology. Institutions have little direct impact on productivity or income. External environmental assistance, human resource performance, farmer participation in groups, and the utilization of Alsintan technology are other factors that have a direct impact on productivity and income. The utilization of Alsintan is directly influenced by institutional performance. Empirical evidence suggests that there is no direct correlation between institutions and the productivity or income of farmers. Despite having their own enterprises, farmer institutions do not directly receive economic advantages. The business's profitability is suboptimal, barely sufficient to cover personal expenses and reinvest in the business. Institutions do not actively promote an improvement in farmers' productivity. Another variable factor that directly enhances agricultural yield is required. Nevertheless, the existence of institutions promotes the proliferation of Alsintan technology. Furthermore, agricultural institutions do not directly engage in enhancing productivity. It requires the support of several entities, including the government, financial institutions, and other organizations, to enable farmer group association (Gapoktan) to assist farmers. The evidence suggests that the influence of institutions on productivity and income is indirect, necessitating the mediation of technological equipment utilization.

As institutional performance improves, farmers will increasingly adopt and embrace the usage of Alsintan technology. Joining a farmer organization will facilitate farmers' access to Alsintan. The findings of this study align with the research conducted by [Lindiawati et al. \(2023\)](#) and [Syahri & Somantri \(2016\)](#), since they highlight the crucial

function of institutions. To foster independent and professional farmer institutions, it is imperative to undertake institutional revitalization. Conversely, investigations by Fitriyana *et al.* (2023) and Pitriani *et al.* (2021), present divergent methodologies. The second study indicates a correlation between institutions and productivity. This study has a limitation; it does not clarify whether the institutional impact on productivity is direct or indirect. Furthermore, these two-research employed a rudimentary statistical analysis of relationships, neglecting additional variables. This renders their study less comprehensive in justifying how institutions can influence productivity and revenue.

However, the direct utilization of Alsintan technology has a substantial impact on both production and income. These findings align with the studies conducted by Pitriani *et al.* (2021), Baiti *et al.* (2023), and Nahraeni *et al.* (2020). Nevertheless, these three- research have failed to elucidate the correlation between Alsintan and other variables that concurrently impact productivity and revenue. The following types of Alsintan directly affect agriculture: post-harvest dryers, water pumps, insect and disease weeding equipment, and rice transplanters. Rice transplanters are more cost-effective than manual labor. The cost of manual planting reach IDR 1,500,000, but using a transplanter incurs rental charges of IDR 700,000 and seed reserve purchase prices of IDR 500,000. Moreover, the utilization of water pumps undeniably affects both productivity and income. The water requirements are crucial in the rice cultivation process.

Hence, this approach is highly suitable for locating water pumps as Alsintan, resulting in a direct influence on production and income. Rice producers have not extensively utilized pest weeding tools. Farmers typically engage in manual weeding using improvised tools. Nevertheless, employing pest weeding equipment can enhance output to a greater extent. An increasingly common piece of pest control equipment is the power weeder, which is specifically designed for removing weeds. For the purpose of drying, the appropriate equipment to utilize is a grain dryer. Indeed, this machine has not been widely utilized as farmers typically market their rice in the form of harvested dry grain (GKP). Sutrisno & Raharjo (2007) demonstrates that the utilization of drying machines can result in increased milling yields, improved quality, and higher prices for rice. Other factors, such as TR2, TR4, and combine harvesters, can also have an indirect impact. According to this, the utilization of Alsintan technology has been demonstrated to effectively enhance productivity and income.

Furthermore, apart from the direct correlation observed between institutions and the use of Alsintan, an indirect correlation was also discovered between institutions and the use of Alsintan, particularly in regard to productivity and revenue. Table 5 displays the findings of an indirect effect analysis on the structural equation model (SEM) of institutions and the utilization of Alsintan in Central Lampung Regency. The implications drawn from the analysis of the indirect influence in the institutional model and the utilization of Alsintan in Central Lampung Regency is that:

1. The use of Alsintan Technology is positively and significantly influenced by Human Resources Performance through Institutional Performance (Original Sample = 0.186 (positive) and p -value < 0.05).
2. Institutional Performance positively and significantly influences the utilization of Alsintan Technology, as indicated by a positive coefficient (Original Sample = 0.223 (positive)) and a p -value < 0.05.
3. The results indicate that there is no significant relationship between HR Performance and Productivity, as evidenced by a p -value > 0.05 in the analysis of Institutional Performance.
4. The results indicate that Group Membership Participation does not have a statistically significant impact on Productivity, as evidenced by a p -value > 0.05.
5. Based on the analysis of Institutional Performance and the use of Instruments, it has been shown that Human Resources Performance does not have a statistically significant impact on Productivity (p -value > 0.05).
6. The application of Alsintan Technology has a direct and substantial impact on Productivity, as evidenced by a positive coefficient (Original Sample = 0.306) and a statistically significant p -value (< 0.05) indicating a strong relationship between Institutional Performance and Productivity.
7. The utilization of Alsintan technology and the performance of institutions have a direct and meaningful impact on productivity. This impact is positive (Original Sample = 0.141) and statistically significant (p -value < 0.05).
8. The Institutional Performance does not have a significant impact on the Farm Income Level, as indicated by the p -value > 0.05.
9. The Income Level is not significantly affected by Group Membership Participation through Institutional Performance (p -value > 0.05).

Table 5. Results of indirect effect analysis on institutional SEM and the use of Alsintan in Central Lampung Regency

Indirect Effect Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	t-Statistic (O/STDEV)	p-value
Human Resources Performance → Institutional Performance → Use of Alsintan Technology	0.186	0.213	0.081	2.304	0.022
Group Membership Participation → Institutional Performance → Use of Alsintan Technology	0.223	0.227	0.086	2.604	0.009
HR Performance → Institutional Performance → Productivity	0.029	0.029	0.081	0.352	0.725
Group Membership Participation → Institutional Performance → Productivity	0.034	0.032	0.082	0.417	0.677
Human Resources Performance → Institutional Performance → Use of Alsintan Technology → Productivity	0.117	0.134	0.060	1.947	0.052
Institutional Performance → Use of Alsintan Technology → Productivity	0.306	0.325	0.090	3.381	0.001
Group Membership Participation V Institutional Performance → Use of Alsintan Technology → Productivity	0.141	0.145	0.066	2.136	0.033
Human Resources Performance → Institutional Performance → Farm Income Level	-0.027	-0.026	0.128	0.212	0.832
Group Membership Participation → Institutional Performance → Farm Income Level	-0.033	-0.027	0.131	0.249	0.804
Human Resources Performance → Institutional Performance → Use of Alsintan Technology → Farm Income Level	0.113	0.126	0.066	1.720	0.086
Institutional Performance → Use of Alsintan Technology → Farm Income Level	0.294	0.306	0.109	2.689	0.007
Group Membership Participation → Institutional Performance → Use of Alsintan Technology → Farm Income Level	0.135	0.135	0.067	2.033	0.043

10. The use of Alsintan technology and institutional performance do not have a statistically significant impact on the income level of farming, as indicated by a p -value > 0.05 .
11. The utilization of Alsintan technology has a demonstrably positive and statistically significant impact on the income level of farming. This is indicated by an observed positive coefficient (Original Sample = 0.294) and a p -value < 0.05 , which confirms the significance of the relationship.
12. The utilization of Alsintan technology and active participation in group membership have a favourable and statistically significant impact on farming income (Original Sample = 0.135 (positive) and p -value < 0.05).

According to the findings of the indirect effect study, institutional performance plays multiple significant roles as intermediates. The primary function is to establish a connection between HR performance and group membership involvement through the utilization of Alsintan technology, resulting in a noteworthy and favorable impact. Furthermore, the utilization of Alsintan technology, in conjunction with institutional performance, establishes a correlation between group membership involvement and both productivity and income, resulting in a notable and favorable impact. Institutional performance can have a positive and significant impact if the usage of technology improves productivity and income. Put simply, if farmers employ Alsintan technology in their cassava farming, Institutional Performance will positively and significantly impact both productivity and income levels.

In addition, the findings of these investigations indicate that institutions play a crucial role in promoting higher productivity and income for farmers. The effective performance of institutions, along with the active involvement of human resources and their engagement in farmer organizations, plays a crucial role in promoting the use of Alsintan technology in rice cultivation. The strength of farmer institutions is demonstrated by their ability to effectively perform various functions and fulfil institutional roles. Farmer groups serve as a platform for farmers to express their aspirations and act as catalysts for the agricultural economy through independent initiatives. They also provide

guidance and support to farmers in their farming activities, while facilitating collaboration between farmers and agribusiness support institutions such as extension workers, government agencies, universities, and financial institutions. In addition, productivity and income exhibit a positive correlation, meaning that when productivity rises, income also rises in tandem. Furthermore, the institution and the utilization of Alsintan technology are two interconnected and mutually reinforcing factors. Thus, enhancing the capacity of institutions, along with a greater use of agricultural machinery and equipment (Alsintan), can serve as an ideal development framework to enhance farmers' productivity and revenue.

The aid program for the acquisition of agricultural machinery and equipment by the Ministry of Agriculture and other agencies should be supplemented by proactive measures and the strengthening of farmers' institutions. The absence of robust farmer organizations will impede the adoption of Alsintan technology, and conversely. Furthermore, it is imperative to promote the commercialization of farmer institutions in order to directly enhance the economic advantages for farmers. The level of social and administrative activity should be minimized to avoid it becoming excessively prevalent per unit area per season. If farmer institutions can offer supplementary incentives to farmers, the farmers will prioritise enhancing their farming practices and expanding their farmer organizations.

Furthermore, as stated by Saragih *et al.* (2023), enhancing the institutional capacity of rice farmers is a key approach to augmenting and sustaining national rice output. In order to ensure the effectiveness of institutions, it is crucial to provide them with comprehensive and up-to-date agricultural counselling, as emphasised by Sapar *et al.* (2018). Aldillah (2016) and Agustin *et al.* (2019) both highlighted the significance of having sufficient and comprehensive agricultural machinery in terms of minimising farming expenses and benefiting farmers.

4. CONCLUSION

Based on results and discussion we can conclude that there is a strong and meaningful correlation between institutional performance, the utilization of Alsintan technology, and both productivity and income levels. Technology has a direct impact on productivity and income with coefficients of 0.63 and 0.60, with confidence levels of 99.9% and 99.7%, respectively, whereas institutional performance has an indirect impact possessing a coefficient of 0.30 and a confidence level of 99.99%. The optimal approach to enhancing productivity and income involves synergizing the enhancement of institutional performance with the utilization of Alsintan technology, while also promoting the improvement of other factors such as human resource performance, group member participation, and external environmental support.

The result suggests the necessity of promoting two intermediary factors, specifically institutional performance and the use of Alsintan, in order to stimulate an augmentation in productivity and farmers' income. The provision of Alsintan aid program by relevant institutions should be supplemented with the empowerment of farmer organizations. Enhancing farmer organizations can occur concurrently with the UPJA revitalization initiative. The government should promote UPJA's development as an autonomous and professional entity. UPJA can serve multiple functions, not alone as a lessor, but also by offering advise to farmers or agricultural collectives regarding the utilization of Alsintan and overseeing the movement of Alsintan within the villages.

REFERENCES

- Agustin, T., Suyudi, S., & Nuryaman, H. (2019). Kinerja kelembagaan agribisnis pepaya California. *Agriстан*, *1*(2), 106-116.
- Aldillah, R. (2016). Kinerja pemanfaatan mekanisasi pertanian dan implikasinya dalam upaya percepatan produksi pangan di Indonesia. *Forum Penelitian Agro Ekonomi*, *34*(2), 163-177.
- Baiti, N.N., Suminah, S., & Winarno, J. (2023). Hubungan tahapan dalam proses keputusan inovasi transplanter padi bagi petani di Kecamatan Trucuk, Kabupaten Klaten. *Jurnal Multidisiplin West Science*, *2*(2), 89-102. <https://doi.org/10.58812/jmws.v2i02.204>
- Bukchin, S., & Kerret, D. (2020). The role of self-control, hope and information in technology adoption by smallholder farmers – A moderation model. *Journal of Rural Studies*, *74*, 160–168. <https://doi.org/10.1016/j.jrurstud.2020.01.009>
- Effendy, L. (2020). Model pengembangan kelembagaan petani menuju kelembagaan ekonomi petani di Kecamatan Sindangkasih Ciamis. *Jurnal Ekonomi Pembangunan STIE Muhammadiyah Palopo*, *6*(1), 38-47. <https://doi.org/10.35906/jep01.v6i1.492>

- Fitriyana, I., Hasanuddin, T., Syarif, Y.A., & Gitosaputro, S. (2023). Penggunaan alsintan dan produktivitas usahatani padi sawah di Desa Semuli Jaya, Kecamatan Abung Semuli, Kabupaten Lampung Utara. *Jurnal Ekonomi Pertanian dan Agribisnis*, 7(2), 573-578. <https://doi.org/10.21776/ub.jepa.2023.007.02.13>
- Haekal, A.A., Derriawan, D., & Zulkifli, Z. (2021). Pengaruh kinerja dan karakteristik individu serta lingkungan institusi terhadap produktivitas publikasi ilmiah guna mendukung reputasi universitas. *Excellent*, 8(1), 33-50.
- Ikuemonisan, E.S., Mafimisebi, T.E., Ajibefun, I., & Adenegan, K. (2020). Cassava production in Nigeria: Trends, instability and decomposition analysis (1970–2018). *Heliyon*, 6(10), e05089. <https://doi.org/10.1016/j.heliyon.2020.e05089>
- Juliandi, A. (2018). Structural equation model partial least square (SEM-PLS) dengan SmartPLS. *Modul Pelatihan Dosen-Dosen Program Studi Administrasi Bisnis, Universitas Sumatera Utara*, 11 Mei 2018. <https://doi.org/10.5281/zenodo.1243777>
- Lindiawati, H., Sriningsih, E., & Widyarini, I. (2023). Peran kelompok tani dalam peningkatan produktivitas padi di Desa Kedungjaya Kecamatan Babelan Kabupaten Bekasi. *Jurnal Ilmu-Ilmu Pertanian*, 25(1), 65-74. <https://dx.doi.org/10.30595/agritech.v25i1.15349>
- Nahraeni, W., Masitoh, S., Rahayu, A., & Awaliah, L. (2020). Penerapan Good Agricultural Practices (GAP) jeruk pamelo (*Citrus maxima* (Burm.) Merr.). *Jurnal Agribisains*, 6(1), 50–59. <https://doi.org/10.30997/jagi.v6i1.2804>
- Nurwiana, I. (2019). Faktor yang berpengaruh terhadap kinerja sistem irigasi di wilayah semi-arid Pulau Timor melalui pendekatan principal component analysis. *Jurnal Irigasi*, 14(2), 89-102. <https://doi.org/10.31028/ji.v14.i2.89-102>
- Pagala, M.A.Y., Nurdyah, N., Aliyah, S.N., & Saleh, M. (2023). Persepsi petani terhadap peran dan fungsi kelembagaan petani kakao di Kecamatan Binuang Kabupaten Polewali Mandar. *AGROVITAL : Jurnal Ilmu Pertanian*, 8(2), 215-220.
- Pitriani, P., Fauzan, F., & Fikrman, F. (2021). Hubungan teknologi alsintan terhadap produktivitas padi sawah di Desa Sungai Puri Kecamatan Tanah Sepenggal Lintas Kabupaten Bungo. *Jurnal Agribisnis*, 23(1), 116-133.
- Rusydi, B.U., & Rusli, M. (2022). Pemanfaatan teknologi pertanian dan pengaruhnya terhadap pendapatan petani. *Journal of Regional Economics*, 1(1), 42-52.
- Sapar, S., Munarka, A.H., & Bustami, L. (2018). Kelembagaan penyuluhan pertanian dalam peningkatan produksi pertanian kakao di Kabupaten Luwu. *Prosiding Seminar Nasional*, 3(1), 266-274.
- Saragih, J.R., Sitepu, D.V.P.A., & Nurhayati. (2023). Analysis of rice fields conversion to improve control strategies: A SWOT framework. *Agro Bali: Agricultural Journal*, 7(2), 333-346. <https://doi.org/10.37637/ab.v7i2.1702>
- Sariati, I., & Hayanti, D. (2023). Transformasi kelembagaan petani menjadi kelembagaan ekonomi petani sebagai model akselerasi pengembangan agribisnis. *Jurnal Suluh Tani*, 1(2), 28-34.
- Sihombing, Y. (2023). Inovasi kelembagaan pertanian dalam mewujudkan ketahanan pangan. *Proceedings Series on Physical & Formal Sciences*, 5, 83–90. <https://doi.org/10.30595/pspfs.v5i.707>
- Syahri, & Somantri, R.U. (2016). Penggunaan varietas unggul tahan hama dan penyakit mendukung peningkatan produksi padi nasional. *Jurnal Litbang Pertanian*, 35(1), 25-36.
- Syofian, S., Sujianto, S., & Handoko, T. (2020). Modal sosial kelembagaan petani karet di Kabupaten Kuantan Singingi. *Gulawentah: Jurnal Studi Sosial*, 5(1), 52-59. <https://doi.org/10.25273/gulawentah.v5i1.6388>
- Soesilowati, E., Martuti, N.K.T., Sumastuti, E., & Setiawan, A.B. (2020). Revitalisasi kelembagaan petani sebagai wahana alih teknologi dan inkubator bisnis pendukung agro techno-park Porwosari, Semarang. *Jurnal Graha Pengabdian*, 2(4), 335-346. <https://doi.org/10.17977/um078v2i42020p335-346>
- Sutrisno, S., & Raharjo, B. (2007). Rekayasa mesin pengering padi bahan bakar sekam (BBS) kapasitas 10 T terintegrasi untuk meningkatkan nilai ekonomi penggilingan padi di lahan pasang surut Sumatera Selatan. *Jurnal Pembangunan Manusia*, 6, 9p.
- Teguh, T.E., Zakaria, W.A., Indah, L.S.M., & Seta, A.P. (2022). Strategies and policies to increase competitiveness of cassava in Lampung Province, Indonesia. *Jurnal Manajemen dan Agribisnis*, 19(3), 492–500. <https://doi.org/10.17358/jma.19.3.492>
- Widiyanti, E., Cahyadin, M., Padmaningrum, D., Suminah, S., & Utari, P. (2023). Tracing farmers' entrepreneurship and communication skills using a bibliometric approach. *Agraris: Journal of Agribusiness and Rural Development Research*, 9(2), 278–298. <https://doi.org/10.18196/agraris.v9i2.233>
- Zakaria, W.A., Endaryanto, T., Ibnu, M., & Marlina, L. (2019). Kesiediaan petani melakukan kemitraan di masa depan: Analisis heckprobit pada petani ubi kayu di Provinsi Lampung. *Journal of Tropical Upland Resources*, 1(1), 19-34.