



Farmers' Perceptions of Climate-Smart Agricultural Innovations and Their Adoption Rate in Praya Tengah District, Central Lombok Regency

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ABSTRACT

This study aimed to evaluate farmer's perceptions and adoption levels of climate-smart agricultural (CSA) technology innovations in Central Praya District, Central Lombok Regency. A quantitative survey approach was employed with 36 farmers who had participated in CSA extension activities. Respondents were selected using a multistage random sampling technique. Data were analyzed using descriptive statistics. The findings indicated that farmers' perceptions were generally high (positive) across all CSA components. The highest positive perception (97.22%) was toward agricultural mechanization, while the lowest (77.78%) was toward the use of vegetable/biological pesticides. Adoption levels were categorized as medium (61.11%) and high (38.89%). Agricultural mechanization was the most applied technology (97.22%), while vegetable/biological pesticide use was the least (58.33%). However, only 38.89% of farmers applied CSA innovations regularly each planting season. Farmers generally perceive CSA positively, but adoption remains uneven. Further research is recommended on adoption drivers and the impacts on costs and income.

INTRODUCTION

The agricultural sector is one of the important sectors in national development both in the past, present and in the future, the agricultural sector plays an important role in the provision of food, raw materials for the agricultural industry, labor absorption, and the development of the national economy. In an effort to increase food production, Indonesia has implemented the green revolution in the development of the agricultural sector since 1960. Through the implementation of the green revolution, Indonesia succeeded in significantly increasing rice production and achieving rice self-sufficiency for the first time in 1984 with rice production reaching 27.7 million tons. The green revolution in Indonesia does not only focus on rice, but also other food crops such as corn, soybeans, and sweet potatoes (Azahra et al., 2024).

NTB has long implemented the Green Revolution through the GORA (gogo rancah) system, a technique of rice cultivation on dry land using limited rainfall. This system succeeded in making NTB the main contributor to national rice self-sufficiency in 1984 and until now remains a national food buffer, with rice production reaching 1.45 million tons and corn 1.21 million tons in 2024 (BPS NTB, 2025). However, this success comes with serious environmental consequences. Agricultural intensification through the excessive use of inorganic fertilizers and chemical pesticides has led to land degradation in the form of decreased soil fertility, loss of important microorganisms, and increased soil acidity resulting in damage to soil structure and dissolution of essential minerals. This impact ultimately reduces the productivity of agricultural land itself. (Widowati et al., 2021).

The loss of microorganisms in the soil has an impact on decreased soil fertility, disruption of nutrient cycles, and decreased soil quality. Microorganisms play an important role in the process of decomposition of organic matter, nutrient absorption by plants, and maintaining soil structure. Microorganisms play an important role in nutrient cycling, such as the nitrogen, phosphorus, and sulfur cycles. The loss of microorganisms can disrupt the cycle, so nutrients are not available in a form that can be used by plants. The use of pesticides on plants, will leave residues on the plant and on the soil and the surrounding environment, if this pesticide residue accumulates in the soil, it will affect the life of organisms in the soil and on the plants grown in the soil (Fitriadi & Putri, 2016).

The decline in agricultural land productivity, in addition to the impact of excessive use of inorganic fertilizers and chemical pesticides, is also due to climatic conditions in the local area, as well as the impact of global climate change that is increasingly occurring. One of the impacts of climate change is a decrease in rainfall intensity or rain variability. In general, rainfall in Indonesia is influenced by several phenomena such as Dipole Mode (DM) and El Nino Southern Oscillation (ENSO). ENSO is a phenomenon of marine atmospheric interactions that occur in the tropical Pacific Ocean between cold (La Niña) and warm periods (El Nino) with periodic fluctuations (Aditya et al., 2021). Meanwhile, Dipole Mode (DM) is a significant phenomenon in the interaction of

the tropical atmosphere that occurs in the Indian Ocean and has a great influence on the surrounding climate (Aditya et al., 2021).

The impact of climate change on the agricultural sector such as changes in rainfall patterns and rainfall patterns, rising air temperatures and sea levels, and increasing the frequency of extreme climates. The result of a long drought will also have an impact on the availability of planting water or poor water drainage so that plants cannot grow and experience crop failure. Prolonged dry seasons can also cause the growing season to be pushed back. If the plant can survive, the harvest produced is also not optimal and has defects in quality. The influence of climate change has an impact on OPT populations that are difficult to predict due to the balance between OPT and its host plants and natural enemies (Mulyandari et al., 2022).

The agricultural sector releases several greenhouse gas emissions, including in the form of CO₂ and N₂O. Total greenhouse gases are produced by the agricultural sector 10-12% of total greenhouse gases. In the future, greenhouse gas emissions are predicted to increase in line with increasing food needs, marginal land use and increased meat consumption. Greenhouse gases that need attention in the agricultural sector include carbonitoxin (CO₂), mentana (CH₄) and nitro dioxide (N₂O), most of which are caused by microbial decay, crop burning, decomposition of organic matter, ruminated livestock manure, and nitrodioxide activities (Horns, 2024).

At this time, paddy rice is the main food commodity that is spurred by productivity through various programs to accelerate food self-sufficiency that have the potential to damage environmental sustainability, if not accompanied by the use of appropriate technology. The damage caused by unenvironmentally friendly land management practices is a decrease in environmental quality such as nitrate residues in water, resistance of plant pest organisms, biodiversity imbalances, poisoning to humans, and decreased product quality (Rivai & Anugrah, 2016). To reduce the impact of land erosion, environmental damage, and the sustainability of food production, it is necessary to improve land management methods, cultivation methods as well as a strategy for adaptation and mitigation of the impact of climate change. In carrying out adaptation and mitigation actions, changes are needed in land management, water management, and crop management to increase production and productivity so that they are able to adapt to the impacts of extreme climate change and reduce the factors that cause global warming in the form of reducing greenhouse gas emissions (Mulyani et al., 2024).

Climate change adaptation and mitigation in the agricultural sector can be carried out through the implementation of Climate Smart Agriculture (CSA). CSA is an environmentally friendly cultivation approach that aims to increase sustainable productivity, adapt to climate change, while reducing greenhouse gas emissions (FAO, 2018). Some CSA technologies include the use of Leaf Color Charts for nitrogen fertilizer efficiency, soil testing, addition of organic matter, and intermittent irrigation. The Ministry of Agriculture's BPPSDMP through the SIMURP program (2019-2023) has held CSA training, demonstration plots, and Farm Field Day in 10 provinces including NTB. This activity has succeeded in

increasing farmer capacity, productivity, and reducing GHG emissions in the agricultural sector (BPPSDM Pertanian, 2023)

Research by Mirawati et al. (2023) shows that the level of knowledge and understanding of farmers towards climate-smart agricultural technology innovations is related to the role of agricultural extension workers as facilitators and dynamizers. The results of the study show that the level of knowledge of farmers is included in the good category, after farmers follow the technical guidance of climate-smart agriculture carried out by agricultural extension workers. Meanwhile, research by Sedyowati et al. (2024) shows an increase in productivity every year of 5.39 Tons/Ha in 2020, 5.46/Ha in 2021 and 5.55 Tons/Ha in 2022, and a decrease in the use of chemical pesticides, seen in the use of carbofuran down 2.07%, the use of insecticides down 2.03%, the use of fungicides down 0.93%, and the use of herbicides down 0.50%, and showing a decrease in CH₄ greenhouse gas (GHG) emissions by 39%, N₂O 0.07 (kg/ha) and GWP 37% (Kg CO₂-e/ha).

The behavior or action of innovation adoption by farmers is generally influenced by the characteristics of innovation, characteristics of farmers, knowledge, experience and perception of farmers towards the characteristics of technological innovation. Research by Ibrahim et al (2020) revealed that the characteristics of farmers, characteristics of technological innovations, and the competence of extension workers have a positive and significant effect on the level of adoption of organic vegetable farming innovations in Batu City. Meanwhile, the nature of the technology that includes relative advantage, suitability, complexity, trial, and ease of observation is in the high category. Meanwhile, Sunandar et al. (2021) stated that the adoption of 2:1 legowo row planting innovations is directly influenced by farmer behavior, as well as indirectly by farmer characteristics, innovation characteristics, types of adoption decisions, and the competence of agricultural extension workers. The characteristics of innovation have a positive indirect influence on the adoption of the 2:1 legowo row. This shows that the better the perception of farmers towards aspects of innovation such as relative profitability, level of suitability, complexity, trial, and ease of observation, the more farmer behavior will also support the implementation of these innovations.

In an effort to increase agricultural commodity production through a land intensification approach, the use of technological innovation is the main component to make it happen. The level of adoption or application of technological innovation by farmers is determined by the level of knowledge, perception or attitude of farmers towards the technological innovation in question. This study aims to examine the level of perception and adoption of farmers towards climate-smart agriculture technology innovation-climate smart agricultur (CSA) in rice cultivation in Central Praya District, Central Lombok Regency. This research is expected to be useful and contribute to determining the strategy of extension in accelerating the application of climate-smart agriculture technology innovations to farmers to realize food self-sufficiency.

THEORETICAL REVIEW

The Impact of the Green Revolution

The implementation of the green revolution in Indonesia, especially through the intensification of agriculture with the application of modern technology such as the use of superior varieties and chemical fertilizers, succeeded in increasing food production and achieving rice self-sufficiency in 1984 (Azahra et al., 2024). However, agricultural intensification leads to land degradation due to excessive use of fertilizers and pesticides that damage soil fertility and soil microorganism proliferation (Widowati et al., 2021). The damage caused by unenvironmentally friendly land management practices is the decline in environmental quality such as increased nitrate residues in water, resistance of plant pest organisms, biodiversity imbalances, poisoning in humans, and decreased product quality (Rivai & Anugrah, 2016).

Impacts of Climate change

Climate change triggers variability in rainfall, drought, and increased temperature, which is influenced by the phenomenon of ENSO and Dipole Mode (Aditya et al., 2021). In the agricultural sector, the impact of climate change has seen changes in rainfall patterns, rising air temperatures and sea levels, causing a decline in the planting season and increasing the risk of crop failure, (Mulyandari et al., 2022). The agricultural sector also contributes 10-12% of GHG emissions through the emission of CO₂, CH₄, and N₂O gases (Rozci, 2024).

CSA Solutions

CSA (Climate Smart Agriculture) is a sustainable solution with three goals: increasing productivity, climate adaptation, and mitigating emissions (FAO, 2018). Technologies such as the use of balanced fertilizers, intermittent irrigation, and organic fertilizers have been proven to increase yields from 5.39 tons/ha to 5.55 tons/ha while reducing the use of chemical pesticides and reducing Greenhouse Gas (GHG) emissions by up to 39% (Sedyowati et al., 2024). The SIMURP program in NTB plays an important role in introducing climate-smart agriculture innovations (BPPSDM Pertanian, 2023).

Innovation Adoption

Rogers (1983) in Muktasam (2023) stated that the rapid and slow process of innovation adoption is influenced by the characteristics inherent in the innovation. Rahayu & Herawati (2021) refers to the theory of Rogers and Shoemakers (1987) stating that farmers' decisions to adopt technology are influenced by the characteristics of innovation such as the direct benefits of technology in the form of relative benefits including higher economic benefits or benefits from reduced costs, the suitability of technology to socio-cultural values, ways and habits in farming, and the complexity of technology application. Year innovation will be quickly accepted by farmers if the elements of the innovation characteristics tend to be positive, on the other hand, if the elements of innovation characteristics are contradictory, the adoption of innovation by farmers tends to be low.

The results of Hadid et al.'s (2023) research show that the rate of farmers' adoption of climate-smart agriculture (CSA) innovations is reflected in the

adoption rate of water management technology components which are at the adoption level at the assessment stage (37.31%), while the soil management technology component and crop management technology components are at the adoption level at the testing stage with values of 52.74% and 59, respectively, 70% with adoption is in the medium category. The results of the research of Farid et al. (2018) show that the attitude of farmers has a positive tendency of 72.5% towards the opportunity of adopting the legowo row planting system, one of the factors that has a positive effect on the chances of adopting the legowo row planting system is the profitability variable, namely the relative profit obtained by farmers when implementing legowo row innovation.

METHODOLOGY

The research method used in this study is quantitative research with a survey method. The analysis units in this study are individual farmers who are members of the group who have participated in counseling activities, technical guidance, farmer courses, demonstration plots of climate-smart agricultural technology innovations in Central Praya District, Central Lombok Regency. The selection of the location of Central Praya District was carried out deliberately (purposive) with the consideration that the location is the location for implementing activities to increase the capacity of farmers and farmer institutions through technical guidance and pilot innovations in climate-smart agriculture technology (CSA) with farmers and groups involved the most compared to other sub-districts. The determination of villages, groups and farmers who became respondents was carried out by multistage random sampling technique with a total of 36 respondents, which was determined using the slovin formula with a margin of error of 15%.

The data sources used in this study consist of primary data and secondary data. The primary data in this research is data obtained from interviews with farmer respondents. Secondary data is data and information obtained from other parties, namely the Central Statistics Agency, the NTB Agriculture Office, and the Central Lombok Agriculture Office. The technical data collection in this study was carried out by means of structured interviews using a list of questions. The variables analyzed in this study consist of the variable level of farmers' perception and the variable of the level of adoption of the components of climate-smart agriculture technology. The measurement of variables in this study uses *likert scale* measurements with 3 scales, namely Agree (S), Neutral (N), Disagree (TS). The variable level of farmers' perception is measured from the respondents' answer scores to the nature of innovation, which includes: The level of relative advantage of innovation, namely the relative advantage of increasing production, and the relative advantage of reducing costs; The level of compatibility of innovation, namely the suitability with the farmer's land, and the suitability with the needs of the farmer and the habits or experiences of the farmers; The level of complexity/complexity of innovation, namely the level of complexity of innovation to be understood and used by farmers; The level of ease of trial is the level of ease of CSA innovation for farmers to try to innovate

independently; and Observability level, namely the level of ease of CSA innovation to be observed by farmers.

Meanwhile, the variable rate of adoption was measured from respondents' responses to the adoption of the climate smart agriculture innovation component in the last 2 years, which included the adoption rate of water-saving technology with intermittent irrigation systems or alternate wet and drying); the level of adoption, management, and utilization of agricultural waste as organic fertilizer; the adoption rate of balanced fertilizer use according to the test results of the rice field soil test device and leaf color chart; the level of adoption of the use of climate-adaptive superior varieties; the level of adoption of planting spacing arrangements with the legowo row system; the level of adoption, utilization and use of plant-based pesticides/biological agencies in integrated pest management; and the level of adoption of the use of agricultural mechanization in the form of hand tractors and combine harvester in the process of land cultivation and harvesting.

Data analysis in this study uses descriptive analysis, namely analysis to describe and summarize data with the aim of providing an overview of data characteristics. The perception variables were analyzed by calculating the weighted value of the scoring mode, then divided into 3 categories with the criteria of scoring mode values 10-16 = low/negative category, 17-23 = medium/somewhat positive category and 24-30=high/positive category. Meanwhile, the technology adoption variables were analyzed by calculating the weighted value of the scoring mode, then grouped with the criteria of mode values 7-11 = low category (no adoption), 12-16 = medium category (adoption in one planting season) and 17-21 = high category (adoption each planting season). Before the categorization of the scores of each indicator in the variable, the interval is calculated with reference to the cumulative score, using the following formula:

$$\text{Interval} = \frac{\text{Maximum Score} - \text{Score Minimum}}{\text{Number of Categories}}$$

RESULTS AND DISCUSSION

Characteristics of respondents

Respondent characteristics are characteristics that describe and distinguish between one respondent and another. The characteristics of the respondents interviewed in this study were gender, age, education level, income level, land tenure and farming experience. Of the 36 respondents interviewed, the characteristics of the respondents were diverse as seen in Table 1.

Based on Table 1, the gender of the respondents is dominated by male farmers, which is 80.6%, and is in the productive age with a percentage of 97.2%. The highest age range (33.3%) was in the age range of 46-55 years. The age range of the respondents was directly proportional to the farming practices of most of the respondents who were quite long, namely more than 20 years of experience with a percentage of 41.7%, and 16-20 years of experience with a percentage of 16.7%.

Table 1. Distribution of respondents based on their characteristics

Characteristics	Quantity (org)	Percentage (%)
Gender		
Man	29	80,6
Woman	7	19,4
Age (years)		
21 - 35	2	5,6
36 - 45	10	27,8
46 - 55	12	33,3
56 - 65	7	19,4
> 65	1	2,8
Farming Experience (yrs)		
< 5	1	2,8
5 -10	6	16,7
11-15	8	22,2
16-20	6	16,7
> 20	15	41,7
Education level		
No School	1	2,8
SD	7	19,4
SMP	5	13,9
SMA	11	30,6
College	12	33,3

Source: Primary data processed (2025)

Judging from the level of education, most of the respondents have secondary education to higher education, there are 13.9% of respondents who have junior high school education, as many as 30.6% have high school education and as many as 33.3% have higher education (PT) and there are 22.2% who have an elementary school education and do not finish elementary school. Education is one of the indicators of one of the formal indicators of the ability and quality of individual human resources (HR), meaning that the higher the respondent's education, it is expected that the more rational the respondents will be in thinking and making decisions in adopting and implementing climate-smart agricultural technology innovations.

Farmer's perception of climate-smart agricultur (CSA) innovations

Farmer's perception of innovation is the result of assessment in farmers' understanding after receiving a series of information, knowledge or experience about a new technological innovation. The level of farmers' perception of climate-smart agriculture innovations as shown in Table 2. Table 2 shows that the level of respondents' perception of climate-smart agriculture innovation is in the high (positive) category for all components of technological innovation, meaning that all technological components receive a positive assessment from the respondent farmers based on the characteristics of climate-smart agriculture innovation. The level of respondents' perception of the use of balanced fertilizers was in the highest positive category, with the number of respondents giving a positive assessment of 36 people (100%), followed by the respondents' perception of agricultural mechanization (97.22%), the use of superior climatic adaptive

varieties (94.44%), the arrangement of planting spacing with the legowo alignment system (91.67%), the management and use of waste/organic matter as organic fertilizers (86.11%), and the use of water-saving technology with intermittent or wet dry irrigation system (86.11%) and the utilization and use of biological pesticides (77.78%).

Table 2. The level of respondents' perception of climate-smart agriculture technology innovations

Variable Perception	Category	Quantity (org)	Percentage (%)
Respondents' perception of the management and use of agricultural waste/organic matter as organic fertilizer	Low	0	0,00
	Medium	5	13,89
	High	31	86,11
Farmers' perception of water-saving technology with intermittent irrigation systems or alternate wet and drying	Low	0	0,00
	Medium	5	13,89
	High	31	86,11
Respondents' perception of the use of fertilizers was balanced according to the test results of the rice field soil test device and the leaf color chart	Low	0	0,00
	Medium	0	0,00
	High	36	100,00
Respondent's perception on climate smart agriculture innovation the use of climate adaptive rice varieties	Low	0	0,00
	Medium	2	5,56
	High	34	94,44
Farmers' perception of planting distance regulation with the legowo row system	Low	0	0,00
	Medium	3	8,33
	High	33	91,67
Respondents' perception of the utilization and use of natural materials as biological pesticides in the control of pest	Low	0	0,00
	Medium	8	22,22
	High	28	77,78
Respondents' perception of the use of agricultural mechanization in the form of hand tractors and combine harvester	Low	0	0,00
	Medium	1	2,78
	High	35	97,22

Source: Primary data processed (2025)

Tables 3-7 are respondents' assessment of the components of climate-smart agriculture technology based on the nature of their innovation. Table 3 explains that based on the relative advantage level of innovation in the management and utilization of agricultural waste (straw, animal manure) as organic fertilizer is in the high category (97.22%), or it can be interpreted that most respondents believe that the utilization and use of organic fertilizers from agricultural and livestock waste It is beneficial for farmers, namely being able to increase production and increase the efficiency of rice production costs. Based on the level of innovation compatibility, respondents' perceptions were more dominant in the high category (50%), the medium category (38.89%) and the low category (11.11%). The utilization and use of organic materials, because In accordance with the nutritional needs of the soil, the needs and culture of farmers.

Table 3. Respondents' assessment of the innovation of utilizing organic agricultural and livestock waste as organic fertilizer

Nature of Innovation	Category	Quantity (org)	Percentage (%)
The relative <i>advantage of</i> innovation includes gains in increased production and reduced costs	Low	0	0,00
	Medium	1	2,78
	High	35	97,22
The level of innovation compatibility includes suitability to the needs of farmers as a substitute for inorganic fertilizers and suitability to the experience of farmers	Low	4	11,11
	Medium	14	38,89
	High	18	50,00
The level of complexity includes the complexity in the power, time, volume and place of composting and transporting to the field	Low	8	22,22
	Medium	15	41,67
	High	13	36,11
The level of trialability of innovation includes the ease of obtaining organic materials and mentoring officers	Low	0	0,00
	Medium	6	16,67
	High	30	83,33
The level of <i>observability</i> includes the ease of observing the pilot, the ease of comparing the results of its application	Low	1	2,78
	Medium	6	16,67
	High	29	80,56

Source: Primary data processed (2025)

When viewed from the level of complexity of innovation, the perception of respondents was dominant in the medium category (41.67%), the high category (36.11%) and the low category (22.22%). This means that technological innovation in managing and utilizing agricultural waste as organic fertilizer is relatively complex and has a high level of complexity. Technological innovations in the management and utilization of agricultural waste as organic fertilizers are considered complicated or complex because they require a long composting time, special processing sites, large volumes, and require a lot of labor in their applications. When viewed from the level of trialability and observability, namely the level of ease of trying and observing, respondents' perceptions are in the high category, meaning that most respondents have the view, that technological innovations in the management and utilization of agricultural waste as organic fertilizers are relatively easy to try (83.33%) or observe (80.56%).

Table 4. Farmers' perception of the use of water-saving technology with intermittent or alternate wet and drying irrigation systems

Nature of Innovation	Category	Quantity (org)	Percentage (%)
The relative <i>advantage of</i> innovation includes gains in increased production and reduced costs	Low	0	0,00
	Medium	7	19,44
	High	29	80,56
The level of innovation compatibility includes the suitability of innovation to the type of soil and culture of farmers	Low	5	13,89
	Medium	12	33,33
	High	19	52,78
The level of complexity of innovation includes the involvement of various parties	Low	11	30,56
	Medium	11	30,56

in setting planting schedules and irrigation schedules	High	14	38,89
The level of innovation trialability includes the ease of obtaining tools, materials and mentoring officers	Low	2	5,56
	Medium	7	19,44
	High	27	75,00
The level of observability of innovation includes the ease of observing the pilot and comparing the results of its application	Low	2	2,78
	Medium	6	11,11
	High	28	86,11

Source: Primary data processed (2025)

Table 4 explains that the level of respondents' perception is in the **high** category (80.56%) based on the relative advantage level of water-saving technology innovations with intermittent irrigation systems are considered beneficial for farmers. Based on the level of compatibility of innovation, it can be seen that the respondents' perception is mostly in the high category (52.78%), the medium category (33.33%) and the low category (13.89%), meaning that most respondents assess the intermittent (wet and dry) irrigation system in accordance with the needs, habits and practices carried out by farmers.

Respondents' perceptions based on the level of complexity of innovation are in the high category (38.89%), medium category (30.56%) and low category (30.56%). This can be interpreted that most respondents consider water-saving technology innovations with intermittent irrigation systems (wet and dry) to have a high level of complexity to be applied and applied by farmers, and only some consider the technology to have low or simple complexity. Water-saving technology innovation is seen as complicated because its application must involve coordination and collaboration between parties in setting planting schedules, setting irrigation schedules and uncertain weather. Meanwhile, based on the level of ease of trialability, it is in the high category (75%) and the level of ease of observability is in the high category 86.11%.

Table 5. Respondents' perception of the use of balanced fertilizers was in accordance with the results of the test of the rice field soil test device and the leaf color chart

Nature of Innovation	Category	Quantity (org)	Percentage (%)
The level of relative advantage of innovation includes the advantages in increasing production and lowering production costs	Low	0	0,00
	Medium	0	0,00
	High	36	100,00
The level of compatibility of innovation includes suitability with plant needs and suitability with farmers' culture and experience	Low	1	2,78
	Medium	9	25,00
	High	26	72,22
The level of complexity includes the availability and accuracy of the type of fertilizer, the amount and time of	Low	5	13,89
	Medium	15	41,67
	High	16	44,44

fertilization, and the analysis of soil nutrient content

The level of ease of trial includes the ease of obtaining balanced fertilizers and the ease of obtaining fertilizer recommendations and officer assistance	Low	0	0,00
	Medium	5	13,89
	High	31	86,11
The level of observability includes the ease of observing experiments/pilots and the ease of comparing the results of their application	Low	1	2,78
	Medium	5	13,89
	High	30	83,33

Source: Primary data processed (2025)

Table 5 shows that the respondent's perception is in the high category (100%) based on the level of relative advantage of innovation, meaning that the respondent has confidence that the use of balanced fertilizer in accordance with the test results of the rice field soil test device and leaf color chart, provides benefits significant for farmers through increasing production yields, increasing the efficiency and effectiveness of nutrient absorption, and the efficiency of fertilizer input costs. Based on the level of compatibility, the respondents' perception of innovation was more dominant in the high category (72.22%), then the medium category (25%) and the low category (2.78%).

Judging from the level of complexity of innovation, respondents' perceptions are mostly in the high category (44.44%), medium category (41.67) and low category (13.89), meaning that most respondents view the use of balanced fertilizers as having a moderate to high level of complexity. Meanwhile, respondents' perceptions of the level of trialability and observability of innovation are in the high category, namely the ease of using balanced fertilizer to be tried and observed, with percentages of 86.11% and 83.33% respectively.

Table 6. Respondents' perceptions of the use of climate-adaptive superior rice varieties

Nature of Innovation	Category	Quantity (org)	Percentage (%)
The relative advantage of innovation includes the advantages of increasing production and lowering production costs	Low	1	2,78
	Medium	2	5,56
	High	33	91,67
The level of compatibility of innovation includes suitability with the needs, methods and culture of farmers	Low	1	2,78
	Medium	4	11,11
	High	31	86,11
The level of complexity of innovation includes higher accuracy of type, quantity, time and price as well as less preferred taste	Low	12	33,33
	Medium	9	25,00
	High	15	41,67
The level of ease of trialing innovation includes the ease of obtaining and trying climate-adaptive rice varieties	Low	0	0,00
	Medium	4	11,11
	High	32	88,89
	Low	2	5,56

The level of observability of innovation includes the ease of observing pilots and the ease of comparing the results of their application	Medium	3	8,33
	High	31	86,11

Source: Primary data processed (2025)

Table 6 shows respondents' perceptions of the use of climate-adaptive superior varieties based on the level of relative advantage of innovation, which are in the high category (91.67%), medium category (5.56%) and low category (2.78%). The use of climate-adaptive rice varieties is considered to be able to increase plant resistance to flood and drought stresses, as well as plant pest organism attacks. Respondents' perceptions based on the level of compatibility of innovation were in the high category (86.11%), the medium category (11.11%) and the low category (2.78%), this means that the innovation is in accordance with the needs and experiences of farmers.

Based on the level of complexity of innovation, respondents' perceptions were mostly in the high category (41.67%), then the low category (33.33%) and the medium category (25%). This means that most farmers view climate-adaptive rice varieties as having a high level of complexity. This is related to the availability of superior varieties in breeders and the consideration of traders' and consumers' preferences for the taste of rice. Meanwhile, based on the level of ease of trialability and observability, respondents have a good (positive) perception of being in the high category, with percentages of 88.89% and 86.11%.

Table 7. Farmers' perception of planting distance regulation with the legowo row system

Nature of Innovation	Category	Quantity (org)	Percentage (%)
The relative advantage of innovation includes gains in ease of maintenance, spurring plant growth and increasing production	Low	0	0
	Medium	0	0
	High	36	100
The level of compatibility of innovation includes suitability with plant needs and suitability with farmers' ways, culture and experience	Low	2	5,56
	Medium	10	27,78
	High	24	66,67
The level of complexity includes the complexity of providing skilled planting tools and manpower as well as the provision of more seeds and fertilizers	Low	3	8,33
	Medium	16	44,44
	High	17	47,22
The level of ease of trial includes the ease of obtaining and trying legowo row planting tools and the ease of getting assistance from officers	Low	0	0,00
	Medium	10	27,78
	High	26	72,22
The level of observability includes the ease of observing experiments/pilots and the ease of comparing the results of their application	Low	1	2,78
	Medium	9	25,00
	High	26	72,22

Source: Primary data processed (2025)

Table 7 shows the respondents' perception of the innovation of planting distance management with the legowo row system. It can be seen that based on the level of relative advantage, the respondent's perception is in the high category (100%), this means that respondents believe that this innovation can make it easier to care for and maintain plants, so that plants grow well and increase production yields. Based on the level of compatibility of innovation, respondents' perceptions were in the high category (66.67%), low category (27.78%) and low category (5.56%), this means that the innovation is in accordance with the needs of the plants, methods and experiences of farmers. Based on the level of complexity of innovation, respondents' perception of the innovation of planting spacing with the legowo row system was in the high category (66.67%), medium category (27.78%) and low category (5.56%), This means that this innovation has a high level of complexity in its implementation. Meanwhile, based on the level of trialability and observability, respondents' perceptions are in the high category, with a percentage of 72% each.

Table 8. Respondents' perception of the creation and the use of biological pesticides in pest control

Nature of Innovation	Category	Quantity (org)	Percentage (%)
The level of relative advantage of innovation includes benefits in reducing pest attacks and production costs.	Low	2	5,56
	Medium	13	36,11
	High	21	58,33
The level of innovation of compatibility includes conformity with the way and culture of farmers and environmental conservation efforts	Low	4	11,11
	Medium	18	50,00
	High	14	38,89
The level of complexity includes farmers' knowledge of crop types and the effectiveness of biological pesticides in controlling pests	Low	3	8,33
	Medium	18	50,00
	High	15	41,67
The level of trialability of innovation includes the ease of obtaining materials, making and trying out botanical pesticides	Low	0	0,00
	Medium	3	8,33
	High	33	91,67
The level of observability includes the ease of observing the example and comparing the results of its implementation	Low	4	11,11
	Medium	6	16,67
	High	26	72,22

Source: Primary data processed (2025)

Table 8 shows the respondents' perception of the manufacture and use of biological pesticides in the control of pests. Based on the relative advantage, respondents' perceptions are in the high category (58.33%), medium category (36.11%) and low category (5.56%), his means that the innovation is relatively easy to make their own by farmers from materials that are around. Based on the level of innovation compatibility, the dominant respondent perception is in the medium category (50%), the high category (38.89), and the low category (11.11%), this means that most respondents view the use of biological pesticides less in accordance with the needs and habits of farmers in controlling pests quickly.

Based on the level of complexity of innovation, respondents' perceptions are in the medium category (50%), the high category (41.67%) and the low category (8.33%), this means that respondents view the manufacture and use of biological pesticides has a medium to high level of complexity, making it difficult to be applied by farmers. While from the level of trialability and observability, respondents have a positive perception that is in the high category with a percentage of 91.67% and 72.22%.

Table 9. Respondents' perception of the use of agricultural mechanization

Nature of Innovation	Category	Quantity (org)	Percentage (%)
The relative advantage of innovation includes the advantages of accelerating soil cultivation and the harvesting process	Low	1	2,78
	Medium	5	13,89
	High	30	83,33
The level of innovation compatibility includes compliance with the needs of farmers in accelerating planting and harvesting	Low	0	0,00
	Medium	3	8,33
	High	33	91,67
The level of complexity of innovation includes the availability of machine tools according to planting and harvesting time and land topography conditions	Low	3	8,33
	Medium	19	52,78
	High	14	38,89
The level of trialability includes the ease of renting agricultural machine tools and the ease of getting officer guidance	Low	0	0,00
	Medium	9	25,00
	High	27	75,00
The level of observability includes the ease of observing the use of agricultural tools and machinery, as well as the results of their application	Low	0	0,00
	Medium	5	13,89
	High	31	86,11

Source: Primary data processed (2025)

Table 9 shows that based on the level of relative advantage of innovation, respondents' perceptions are in the high category (83.33%) of the use of agricultural mechanization, meaning that respondents have a positive perception of the use of agricultural mechanization such as hand tractors and combine harverters in the land cultivation process and harvesting process, because it is able to accelerate the tillage process and harvesting process and reduce crop loss. The respondents' perception based on the level of compatibility of innovation can be seen in the high category (91.67%), this can be interpreted that the respondents view the use of mechanization such as hand tractors and combine harvesters in accordance with the needs and experience of farmers. When viewed from the level of complexity of innovation, respondents' perceptions are in the medium (52.78%) and high category (38.87%) which means that respondents consider agricultural machinery to have a medium to high level of complexity. Meanwhile, from the level of ease of trialability and ease of observability, respondents have a relatively good (positive) perception, namely being in the high category with percentages of 75% and 86.11%.

Adoption Rate of Climate-Climat Smart Agriculture Innovation (CSA)

Innovation adoption is the process of accepting or applying new ideas, ideas, technologies, or practices by individuals or groups in a social system.. Climate-smart agriculture (CSA) is an integrated approach to crop management and cultivation accompanied by adaptation and mitigation measures to improve food security. Table 10 shows the adoption rate of climate-smart agriculture in Central Praya District, Central Lombok Regency.

Table 10. Adoption rate of climate-smart agriculture innovations

CSA Technology Innovation	Category	Quantity (org)	Percentage (%)
Adoption Rate of Climate Smart Agriculture (CSA) Innovation	Low	0	0
	Medium	22	61,11
	High	14	38,89

Source: Primary data processed (2025)

Table 10 shows that in general, the adoption rate of the innovation component of climate-smart agriculture technology in Praya Tengah District, Central Lombok Regency is in the medium category with a percentage of 61.11% of respondent farmers, meaning that most farmers have not applied climate-smart agriculture technology overall and consistently or only in one planting season in the last two years. Meanwhile, those in the high category with a percentage of 38.89% of respondent farmers who have implemented climate-smart agriculture innovations in each planting season, although not all technological components are applied.

The adoption rate of each component of climate-smart agriculture technology in Central Praya District, Central Lombok Regency as shown by Table 11. In the table, it can be seen that the adoption rate of soil management technology innovation components through the utilization and use of organic materials is in the medium category (66.67%), meaning that most of the respondent farmers have implemented soil management technology innovations, although not too often or only in one planting season in the last two years. Meanwhile, those in the high category (27.78%) by applying the use of organic fertilizers in each planting season and there are a small number in the low category (5.56%) of respondents who have not used and used organic fertilizers. In the water management component through water management with an intermittent system or wet-dry irrigation, it can be seen that the respondents' adoption rate is in the medium (50%) and high category (27.78%), meaning that most of the respondent farmers have implemented water management with an intermittent or wet-dry irrigation system, even though it is only in one crop season, and there are 27.78% who have applied to every planting season in the last 2 years.

Table 11. Adoption rate of climate-smart agriculture innovations

CSA Technology Innovation	Category	Quantity (org)	Percentage (%)
	Low	2	5,56
	Medium	24	66,67

Management and utilization of agricultural waste (straw, animal manure, natural materials) as organic fertilizer	High	10	27,78
Use of technology water saving with <i>intermittent</i> or alternate wet and drying irrigation system	Low	8	22,22
	Medium	18	50,00
	High	10	27,78
The Use of climate-adaptive Superior rice varieties (drought stress resistance, soaking resistance, pest resistance)	Low	1	2,78
	Medium	7	19,44
	High	28	77,78
Planting distance setting with legowo row system	Low	3	8,33
	Medium	22	61,11
	High	11	30,56
The use of balanced fertilizer is in accordance with the test results of the field soil test device and leaf color chart	Low	3	8,33
	Medium	16	44,44
	High	17	47,22
Utilization and use of natural materials (neem, papaya leaves, trichoderma) as biological pesticides in pest control	Low	15	41,67
	Medium	18	50,00
	High	3	8,33
The use of hand tractors and Combine harvesters in the processing of land and harvest	Low	1	2,78
	Medium	2	5,56
	High	33	91,67

Source: Primary data processed (2025)

The adoption rate of crop management technology components through the use of climate adaptive superior varieties based on high category (77.78%) and medium category (19.44%) means that as a large number of farmers have used climate adaptive superior rice varieties in each growing season, and only a small percentage of farmers have applied only in one growing season in the last 2 years. While in the application of spacing arrangements with the legowo row system, the adoption rate of respondent farmers is in the medium category (61.11%), high category (30.56%) and low category (8.33), meaning that respondent farmers have adopted spacing arrangements with the legowo row system, and only a small percentage have not applied in the last 2 years. The adoption rate of balanced fertilizer use is in the high category (47.22%), medium category (44.44%) meaning that the respondent farmers have applied balanced fertilization in each rice growing season in the last two years and some farmers only apply it in one growing season.

The adoption rate of respondent farmers in the utilization and use of biological pesticides is in the low category (44.67%), medium category (50%), high category (8.33) meaning that most (58.33%) of respondent farmers have applied biological pesticides in pest control and there are 44.64% of respondent farmers who do not apply. Most of the respondents have adopted agricultural mechanization or are in the high category (91.67%), meaning that most of the respondents farmers in the process of tillage have used agricultural machinery such as hand tractors and in the process of harvesting using combine harvesters. This shows that the respondent farmers have realized the benefits of the use of

agricultural tools and machinery in accelerating the process of tillage, planting and harvesting.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the research and discussion above, the overall perception of farmers on the components of climate smart agriculture (CSA) is high, meaning that farmers have a positive assessment of all components of climate smart agriculture technology innovation. Respondents' perceptions of the components of climate-smart agricultural technology are the use of balanced fertilizers (100%), agricultural mechanization (97.22%), the use of climate-adaptive superior rice varieties (94.44%), spacing arrangement of *jajar legowo* (91.67%), utilization and use of agricultural-livestock waste as organic fertilizer (86.11%), water management with intermittent/wet-dry irrigation systems (86.11%) and the use of biological pesticides (77.78%).

The adoption rate of climate-smart agricultural technology innovation components in Central Praya District, Central Lombok regency is in the medium category (61.11%) and high category (38.89%) meaning that the respondent farmers have implemented climate-smart agricultural technology. The highest rate of adoption of technology components (97.22%) occurred in agricultural mechanization technology components, and the lowest (58.33%) in the use of biological pesticides. The adoption of climate-smart agricultural technology on respondent farmers is still partial and not sustainable, there are only 38.89% of respondent farmers who have implemented climate-smart agricultural technology innovations in each growing season on a regular basis, although not all components of the technology applied. While as many as 61.11% of farmers respondents only apply to one planting season in the last two years.

In order to accelerate and sustain the adoption of climate smart agriculture at the farm level, it is recommended that agricultural extension workers continuously assist farmers in the implementation of climate smart agriculture. The government is expected to develop climate adaptation and mitigation action policies and provide incentives for farmers who implement climate smart agriculture.

FURTHER STUDY

This study was limited to examining farmers' perceptions and levels of adoption of climate-smart agriculture (CSA) technologies. To strengthen the understanding of CSA adoption, future research should focus on several aspects. First, it is necessary to analyze the socioeconomic, cultural, and institutional factors that influence farmers' decisions to adopt CSA innovations more consistently. Second, further studies should investigate the impact of CSA adoption on farm productivity, input efficiency, and household income in order to provide empirical evidence of its economic benefits. Third, longitudinal research is recommended to capture changes in farmers' attitudes and adoption behaviors over multiple planting seasons. Fourth, exploring the role of agricultural extension services, access to credit, and market incentives would provide valuable insights into how enabling environments can accelerate CSA implementation. Lastly, comparative studies across different regions could

identify context-specific drivers and barriers, helping to formulate policies that support sustainable and widespread CSA adoption.

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