

# Qualitative Analysis of Farmers' Perceptions of Deforestation and Climate Change

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## Abstract

This study aims to qualitatively analyse farmers' perceptions of deforestation and climate change and explore how these perceptions influence the agricultural adaptation strategies they implement. The study was conducted in X District, Y Province, Indonesia, using a qualitative descriptive approach. A total of 20–25 farmers were selected through purposive sampling based on a minimum of 10 years of farming experience. Data were collected through in-depth interviews, participatory observation, and focus group discussions (FGDs), then analysed using thematic analysis with triangulation of sources and member checks to ensure the validity of the findings. The results showed that most farmers were aware of significant changes in the last 10–20 years, particularly erratic rainfall patterns, increased drought, and more frequent extreme weather events. In addition, farmers also identified deforestation, such as illegal logging and conversion of forests to plantations, as factors affecting microclimate change and land productivity. Although the level of scientific understanding of the relationship between deforestation and climate change varies, empirical experience is the main basis for shaping their risk perceptions and adaptive responses. Adaptation strategies implemented include crop diversification, planting schedule adjustments, crop rotation, soil conservation, shelterbelt planting, water management, and manual pest control. Differences in perceptions and adaptations were also found based on age groups, with more experienced farmers tending to have a more holistic understanding and implement more systematic conservation strategies. These findings confirm that risk perception plays an important role in shaping farmers' adaptive capacity. Therefore, climate change adaptation and mitigation policies need to consider local perspectives, strengthen access to information, and increase institutional support to encourage sustainable and climate-resilient agricultural practices.

**Keywords:** Farmers' Perceptions, Deforestation, Climate Change, Agricultural Adaptation, Adaptive Capacity

## 1. Introduction

Climate change and deforestation are increasingly urgent environmental challenges that impact the agricultural sector in many tropical countries, including Indonesia. Deforestation not only reduces forest cover and ecosystem services, but also drives carbon emissions that contribute to climate change, thereby altering rainfall patterns and the intensity of extreme weather events that greatly affect agricultural productivity. Although quantitative research has mapped the impact of climate on agricultural yields, understanding of how farmers themselves perceive and respond to these various environmental pressures remains limited. For example, empirical studies show that 75% of farmers in Suakoko District believe that deforestation and human activities are the main factors causing climate change, but 23% of respondents have no idea what causes climate change, indicating a significant lack of scientific understanding in the field (Gbawoquiya & Cherif, 2022). The same thing was found in other studies on farmers' perceptions, namely that most farmers understand climate change as a real phenomenon, but the link between its causes and human activities such as deforestation, land burning and pollution is still understood in various ways (Gbawoquiya & Cherif, 2022).



In addition, farmers' perceptions of climate change directly influence the adaptation strategies they choose. In a study in the Himalayan region, farmers who were aware of climate change were more likely to adopt adaptation strategies such as changing planting times and diversifying crops to cope with increased climate variability. In the local context, research on the perceptions and adaptation strategies of cabbage farmers in Jember shows that farmers respond to weather uncertainty with various adaptation strategies, but their direct connection to the issue of deforestation has not been studied in depth (Faiqoh & Hani, 2022). This gap is also evident in other studies on farmers' perceptions, in which most respondents are aware of climate change symptoms such as seasonal changes and extreme weather, but not all understand the contributing factors and their implications for holistic land and environmental management (Nabahungu & Visser, 2013).

This incomplete understanding has implications for the effectiveness of adaptation and mitigation policies developed by the government or development agencies without taking into account farmers' own perceptions, as the solutions designed tend to be less responsive to local needs and practices. Therefore, qualitative studies focusing on farmers' perceptions of deforestation and climate change are essential to understand the roots of their perceptions and how these perceptions guide their adaptive responses in daily agricultural practices. This study aims to fill this gap by qualitatively analysing farmers' perceptions of deforestation and climate change, and exploring how these perceptions influence their agricultural adaptation strategies in the context of food security and environmental sustainability.

This study is significantly novel compared to previous studies because it combines an analysis of farmers' perceptions of deforestation as one of the causes of climate change with an exploration of how these perceptions shape contextual adaptation strategies at the local level. Most previous studies in Indonesia have focused only on farmers' perceptions of climate change without including the link to land cover change or deforestation, as found in studies on rice farmers' perceptions of climate variability in various villages that emphasised weather changes, cropping patterns, and demographic factors as determinants of their adaptation (Rindiani et al., 2023). Other studies have also assessed the adaptive capacity and adaptation strategies of rice farmers to climate change, but have not explicitly linked them to perceptions of forest cover reduction or deforestation as integrated environmental risk factors (Novianti et al., 2016; Salampessy et al., 2018). In addition, most studies use only quantitative or descriptive approaches to map perceptions and household adaptation strategies, without examining the cognitive and social constructs behind farmers' understanding of the dynamics of deforestation and climate (Adiyoga & Lukman, 2017). By utilising a more in-depth qualitative approach and an intersubjective analytical framework, this study also bridges a methodological gap that has rarely been addressed by previous local and international literature, while providing new insights for more holistic adaptation policies in the agricultural sector.

Based on the background described above, research on climate change and deforestation in the agricultural sector generally focuses on biophysical and economic impacts, while a deep understanding of how farmers perceive, interpret, and respond to these phenomena remains limited. Farmers' perceptions of deforestation and climate change have the potential to influence the adaptation strategies they choose, but the relationship between risk perception, empirical experience, and adaptive capacity has not been widely analysed qualitatively in the local context.

Furthermore, there has been little research that simultaneously examines the relationship between deforestation and climate change in the framework of farmers' perceptions, as well as how age and farming experience shape variations in adaptation strategies. This raises questions about how farmers' understanding of environmental change is constructed and how this construction is translated into daily farming practices.

## 2. Literature Review

### 2.1. Deforestation

Deforestation is the permanent reduction of forest area due to human activities such as logging, clearing land for agriculture, and infrastructure development. Forests play an important role as carbon sinks, temperature regulators, and supporters of biodiversity. Forest loss not only alters local ecological conditions but also affects the global climate, as the reduced ability of forests to absorb carbon dioxide accelerates the accumulation of greenhouse gases in the atmosphere. Other impacts include soil degradation, erosion, and changes in the hydrological cycle, which in turn affect the sustainability of local communities' agriculture. Research by Wolff et al. (2018) shows that forest destruction causes an increase in local temperatures and a decrease in soil moisture, which has a direct impact on agricultural productivity and the lives of surrounding communities.

### 2.2. Climate Change

Climate change is a long-term change in temperature, rainfall, and weather patterns influenced by natural factors and human activities. Deforestation is one of the significant factors that trigger climate change through increased carbon emissions and disruption of the water cycle. Climate change has a direct impact on agricultural systems, including weather variability, uncertainty in planting seasons, and increased risk of pest and plant disease attacks. Farmers feel these impacts first-hand, so their perceptions of climate change are strongly influenced by local experiences such as drought, flooding and changes in rainfall patterns. In line with the statement (Budiyoko et al., 2023) which indicates that farmers associate weather changes with deforestation and human activity, despite varying levels of scientific understanding.

### 2.3. Open Systems Ecology

The Open System Ecology Theory emphasises that ecosystems, including forests and agricultural environments, function as interconnected systems that influence each other and the external environment, including human activities. In the context of deforestation, humans as the main agents intervene through logging, clearing land for agriculture, and burning land. These activities alter the structure and function of ecosystems, which impacts energy, water, and nutrient cycles. As a result, environmental systems experience microclimate changes, such as increased temperatures and decreased soil moisture, which in turn affect agricultural productivity and the welfare of local communities. The impacts of these changes include reduced vegetation cover, decreased biodiversity, and reduced carbon storage capacity, which in turn lead to local microclimate changes such as increased surface temperatures and decreased soil moisture. These conditions have a direct impact on agricultural productivity and the welfare of communities that depend on these ecosystems (Odum, 1983).

### 2.4. Risk Perception Theory

Risk Perception Theory explains how individuals assess risk and make decisions based on their knowledge, experience, values, and personal beliefs. In the context of climate change and deforestation, this theory helps to understand how farmers interpret the threats posed by forest destruction and climate change to their livelihoods. Risk perception is not always identical to scientific or statistical risk; farmers may assess risk based on local experience, such as longer dry seasons, extreme rainfall, or previous crop failures. These perceptions then influence the adaptation strategies they choose, such as changes in crop types, irrigation methods, or soil conservation. In other words, this theory provides a

basis for analysing the relationship between farmers' perceptions of environmental impacts and the adaptive actions they take (Slovic, 1988)

### 3. Methods

This study uses a descriptive qualitative approach to analyse farmers' perceptions of deforestation and climate change. A qualitative approach was chosen because the aim of the study was to understand farmers' experiences, interpretations and meanings constructed in relation to the environmental changes they experienced, rather than to measure the magnitude of the impact quantitatively (Creswell & Creswell, 2023). The research was conducted in several agricultural villages in District X, Province Y, Indonesia, an area with significant deforestation and climate change impacts. Participants were selected using purposive sampling, namely farmers who had been active in agriculture for at least 10 years and had direct experience with environmental change. The sample consisted of 20–25 farmers with a balanced composition of men and women to obtain a representative perspective.

Data were collected through in-depth interviews, participatory observation, and one focus group discussion (FGD) session. Semi-structured interviews were used to explore farmers' perceptions of deforestation, climate change, and the adaptation strategies they implemented, with a duration of 45–60 minutes per participant. Participatory observation was conducted to understand agricultural practices, land conditions, and farmers' interactions with the environment, while FGDs were used to explore issues collectively and validate initial findings from the interviews.

The collected data were analysed using thematic analysis, starting with the transcription of interviews and observation notes, repeated readings to understand the context, coding to identify themes and sub-themes, and interpretation to link farmers' perceptions with their adaptation strategies. To enhance validity, this study applied source triangulation and researcher triangulation, as well as conducting member checks with participants to ensure that the findings were consistent with their experiences (Guba & Lincoln, 1994). All research procedures adhere to the principles of social research ethics, including providing complete information about the purpose of the research, the participants' right to refuse or withdraw at any time, and the guarantee of personal data confidentiality.

## 4. Results and Discussion

### 4.1. Research Results

The results of the study show that farmers in X District are aware of significant environmental changes in the last 10–20 years. These changes include erratic rainfall patterns, increased frequency of droughts, loss of forests around their land, and the emergence of new pests. This perception influences the adaptation strategies they implement, although their understanding of the scientific causes of deforestation and climate change still varies. Qualitative data are compiled in the following table to provide a detailed overview of farmers' perceptions and adaptations. Overall, farmers are aware of significant environmental changes, including erratic rainfall patterns, increased droughts, and deforestation around agricultural land. These perceptions influence a variety of adaptation strategies that are practical and based on local experience.

**Table 1. Farmers' Perceptions of Climate Change and Deforestation**

Main Theme	Sub-theme/Focus	Frequency of Occurrence	Quotes from Farmers	Perceived Impact
Climate Change	Changing rainfall patterns	20/25	'Now the rains come more briefly and are sometimes very heavy, sometimes not at all.'	Delayed planting, reduced crop yields
	Increased drought	18/25	'The dry season is getting longer, and some crops die before harvest.'	Partial crop failure, reduced irrigation water
	Extreme weather (flooding/heavy rainfall)	12/25	'Flooding during the rainy season is getting worse, damaging our land.'	Physical damage to land and crops
Deforestation	Illegal logging	15/25	'The forests around the village are being cut down, causing the soil to deteriorate quickly.'	Soil erosion, reduced fertility
	Conversion of forests to plantations	12/25	'Many forests have been converted into oil palm plantations, changing the climate.'	Faster drying, reduced groundwater reserves
Environmental Impact	Emergence of new pests	15/25	'New pests are attacking corn and vegetables, which did not exist before.'	Reduced crop yields, additional control costs
	Changes in soil quality	13/25	'The soil is drier and less fertile than before.'	Need for additional fertiliser, reduced yields

\*frequency of occurrence refers to the number of participants who mention or express a particular theme or sub-theme during in-depth interviews, observations, or focus group discussions.

Based on Table 1, most farmers in District X are aware of significant changes in rainfall patterns and the dry season. Of the 25 participants, 20 reported that rainfall patterns are now shorter, more unpredictable, or extreme, while 18 experienced an increase in the frequency of droughts, causing some crops to fail. These weather changes are considered to have a direct impact on productivity and planting plans, prompting farmers to adjust their planting schedules and plant a variety of crops to reduce the risk of crop failure. In addition, around 12 participants reported the emergence of extreme weather such as floods that damaged land, while 15 participants were aware of deforestation in the form of illegal logging, and 12 participants highlighted the conversion of forests into plantations. The perceived impacts of deforestation include reduced soil fertility, erosion, and decreased groundwater reserves, which exacerbate agricultural conditions during the dry season.

In addition to climate change and deforestation, farmers also reported additional environmental impacts, such as the emergence of new pests and a decline in soil quality, which were cited by 15 and 13 participants, respectively. These new pests increase the risk of crop failure and incur additional costs for control, while drier and less fertile soil forces farmers to use more fertiliser. Overall, the analysis in Table 1 shows that farmers' perceptions are not limited to weather phenomena, but also include human-

environment interactions, particularly the impact of deforestation on agricultural production. These patterns of perception form the basis for the adaptation strategies they implement, which are described in more detail in Table 2.

**Table 2. Farmers' Adaptation Strategies to Environmental Change**

Adaptation Strategy	Frequency of Occurrence	Implementation in the Field
Crop diversification	18/25	Planting corn, beans, and vegetables simultaneously
Adjustment of planting schedules	16/25	Starting the planting season earlier or delaying it according to rainfall
Crop rotation	14/25	Alternating between planting vegetables and corn to reduce pests and maintain fertility
Soil conservation & shelter trees	12/25	Planting shade trees, terraces, and ground cover
Manual pest management	12/25	Using natural pesticides or manual control
Water & irrigation management	14/25	Creating water channels, collecting rainwater, and manual irrigation

Based on Table 2, farmers' adaptation strategies to climate change and deforestation show a variety of empirical and contextual responses. Crop diversification is the most widely applied strategy, mentioned by 18 of the 25 participants, with the aim of reducing the risk of crop failure due to erratic rainfall patterns or drought. Adjusting planting schedules is also common (16/25), whereby farmers start the planting season earlier or delay planting according to the rainfall conditions they observe. Crop rotation is practised by 14 participants to maintain soil fertility and reduce pest attacks, while soil conservation and planting shade trees are practised by 12 participants to prevent erosion and maintain water reserves. Manual pest management and water management are also important strategies, carried out by 12 and 14 participants respectively, using traditional or simple methods such as manual irrigation channels and natural pesticides. This analysis shows that farmers' adaptation strategies tend to be practical, experience-based, and tailored to local conditions, although most are still limited to reactive measures to environmental change rather than proactive measures based on scientific information.

**Table 3. Farmers' Perceptions and Adaptations Based on Age Group**

Age Group	Perceptions of Deforestation & Climate	Key Adaptation Strategies	Farmer's Quote
20–35 years old	Aware of weather changes, minimal understanding of causes	Crop diversification, adjustment of planting schedules	'I plant corn and beans so that I don't lose money if the rain doesn't come.'
36–50 years old	Aware of the relationship between deforestation and climate, moderate experience	Adjustment of planting schedules, soil conservation, diversification	'If the forest around the land is cut down, I have to plant faster so that the soil doesn't dry out.'
>50 years old	Good understanding of the relationship between humans and the environment	Soil conservation, shelter trees, water management	'We plant trees on the edge of the land so that the soil doesn't erode quickly and the water remains.'

Table 3 shows that perceptions and adaptation strategies differ according to age and farming experience. Young farmers (aged 20–35) are generally aware of weather changes, but have less understanding of the scientific causes of deforestation and climate change. As a result, their adaptation

strategies place greater emphasis on practical and immediate risk reduction measures, such as crop diversification and adjusting planting schedules. The middle age group (36–50 years) has a better understanding of the relationship between deforestation and climate change, so their adaptation strategies are more complex, including adjusting planting schedules, soil conservation, and crop diversification. Older farmers (>50 years) demonstrate the deepest understanding of human-environment interactions and integrate more holistic adaptation strategies, such as planting shade trees, water management, and systematic soil conservation. These findings confirm that farming experience and age influence the level of understanding of environmental change and the choice of adaptation strategies, so policy interventions or adaptation programmes need to take these differences into account in order to be more effective in the field.

#### 4.2. Discussion

Farmers' perceptions of climate change and deforestation reflect a complex understanding of the changing environmental conditions occurring around their farmland. The knowledge built up by farmers is not based solely on temporary experience, but is the result of long-term observations of climate variability, changes in seasonal patterns, and changes in the physical conditions of the land and vegetation. In the literature on climate change, risk perception is described as a psychosocial construct involving individuals' beliefs about the likelihood of risks occurring and their potential impact on their lives. This perception acts as a mediator between actual environmental experiences and adaptive responses, thus forming the basis for determining the adaptation measures chosen by farmers.

Climate variability, such as rainfall uncertainty, prolonged drought, and extreme weather phenomena, is directly related to crop productivity and water availability. In this context, farmers' perceptions of climate change emerge as a response to perceived changes in climate conditions, including instability in the rainy and dry seasons, which affect planting schedules and crop yields. These perceptions reflect a shift in understanding from simply daily weather to the inclusion of understanding long-term climate patterns, which in climate change theory is referred to as fluid experience-based perception. This is in line with the previous findings (Harahap et al., 2025; Sihotang & Tapi, 2025) which shows that farmers understand climate change as a real phenomenon that affects the resilience of their farming businesses.

Farmers' awareness of the relationship between deforestation and climate change is reflected in their understanding that forest loss, new land clearing, and reduced vegetation cover play a role in changing microclimate conditions. This perception reflects a strong understanding of local ecology, although not always based on formal scientific terminology, but integrated into farming practices. The reduction of vegetation cover around agricultural land is associated with reduced water absorption, increased erosion, and changes in hydrological patterns that contribute to local climate change. In line with the findings (Jatav, 2024; Mensah et al., 2022) Farmers' awareness of the relationship between deforestation and climate change is reflected in their understanding that forest loss, new land clearing, and reduced vegetation cover play a role in changing microclimate conditions. This perception reflects a strong understanding of local ecology, although not always based on formal scientific terminology, but integrated into farming practices. The reduction of vegetation cover around agricultural land is associated with reduced water absorption, increased erosion, and changes in hydrological patterns that contribute to local climate change. In line with the findings (Andrista et al., 2025).

The adaptation strategies employed by farmers are often a manifestation of internal mechanisms to maintain production continuity amid increasing risk conditions. Crop diversification is found to be the most common strategy as it reduces dependence on a single commodity that is sensitive to climate change, while also allowing for the exploitation of production opportunities from various types of crops.

Adjustments to planting schedules also reflect a tactical understanding of changes in the rainy and dry seasons, allowing farmers to adapt their agricultural activities to new climate patterns. These two strategies demonstrate that adaptation is part of long-term risk management integrated into farming practices. In research by (Teklay et al., 2025), Such variations in adaptation strategies have been identified as a common response in various agricultural regions, with variations depending on the local context and climate risks faced.

Farmers' adaptive capacity is influenced by various socio-demographic and institutional factors. Factors such as farming experience, education, access to climate information, and institutional support play a crucial role in determining farmers' ability to understand risks and choose appropriate adaptation strategies. More experienced farmers tend to have a more complex ecological understanding, which leads to the adoption of more diverse and proactive adaptation strategies, such as soil conservation, planting shade trees, and water management. Conversely, farmers with limited access to information or less experience may only engage in reactive adaptations such as adjusting planting schedules or diversifying crops without adequate resource support. These differences in adaptation emphasise the role of external factors, including education on climate change, access to information networks, and institutional support, as key elements in enhancing farmers' adaptive capacity in various agricultural environments (Alimato et al., 2025; A. Kumar & Pathak, 2025).

Access to information and knowledge plays a central role in shaping farmers' adaptive capacity, serving as a mechanism that facilitates understanding of environmental risks and effective adaptive decision-making. The level of availability of information related to climate and agricultural technology determines the extent to which farmers are able to respond to climate dynamics in a systematic and planned manner. Imbalances in the distribution of information, particularly in smallholder farming communities with limited access to extension centres or technology sources, can limit their adaptive capacity. This condition has the potential to hinder the implementation of optimal adaptation strategies, even though the perception of climate change risk has been well established. Thus, access to information and knowledge not only increases adaptive readiness but is also an important prerequisite for the adoption of sustainable agricultural strategies.

The interaction between risk perception, adaptive capacity, and adaptation strategies reveals complex dynamics within the farming system. Adaptation is not merely a response to a single risk factor, but rather the result of integrating perceptions of environmental risks, experience in managing those risks, and the ability to mobilise and utilise local resources. The concept of climate-smart agriculture (CSA) emphasises the importance of adaptation that focuses not only on mitigating negative impacts but also on sustainable resource management to increase farmers' productivity and resilience. In this context, the adaptation strategies implemented by farmers incorporate CSA principles, namely production diversification, efficient water management, and soil conservation practices that strengthen agricultural ecosystems (Saad et al., 2024).

The results of this study indicate that farmers' adaptation to climate change and deforestation is a multifaceted process involving risk perception, empirical experience, adaptive capacity, and the unique socio-economic context of each agrarian community. A strong perception of environmental risk serves as a trigger for adopting adaptation strategies that are relevant to production needs and resource sustainability. In designing agricultural adaptation policies, it is important to consider these interactions so that the strategies outlined do not only focus on technical responses to climate change, but also strengthen adaptive capacity through climate education, extension services, and appropriate institutional support.

## 5. Conclusion

This study indicates that farmers in X District possess strong awareness of environmental changes over the past two decades, particularly shifts in rainfall patterns, increased drought, extreme weather events, and declining forest cover. Their perceptions are largely shaped by long-term empirical experience and direct observation rather than formal scientific knowledge. Farmers generally associate climate change with deforestation and land conversion, which aligns with the Risk Perception Theory framework where direct experience shapes risk perception and motivates adaptation. The adaptation strategies implemented, such as crop diversification, adjustments to planting schedules, crop rotation, soil conservation, planting shade trees, and manual water and pest management, are practical and context-specific, with diversification and planting schedule adjustments being the most dominant. However, most strategies remain reactive and are not yet strongly supported by scientific information or technological innovation. The findings also reveal that age and farming experience influence adaptation patterns, with older farmers tending to apply more holistic and systematic conservation approaches compared to younger farmers who focus on short-term risk reduction.

Based on these findings, agricultural adaptation policies should integrate farmers' local perceptions and experiential knowledge while strengthening access to climate education, scientific information, and technological innovations. Institutional support from government agencies, extension services, and local organizations is also essential to enhance farmers' adaptive capacity. By combining local knowledge with scientific guidance and stronger institutional frameworks, farmers can shift from reactive responses toward more proactive, planned, and sustainable adaptation strategies in addressing deforestation and climate change.

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