Farmers' Perceptions and Awareness of Climate Change Adaptation Strategies in Local Agricultural Practices

A Case Study in the Badulla District, Sri Lanka

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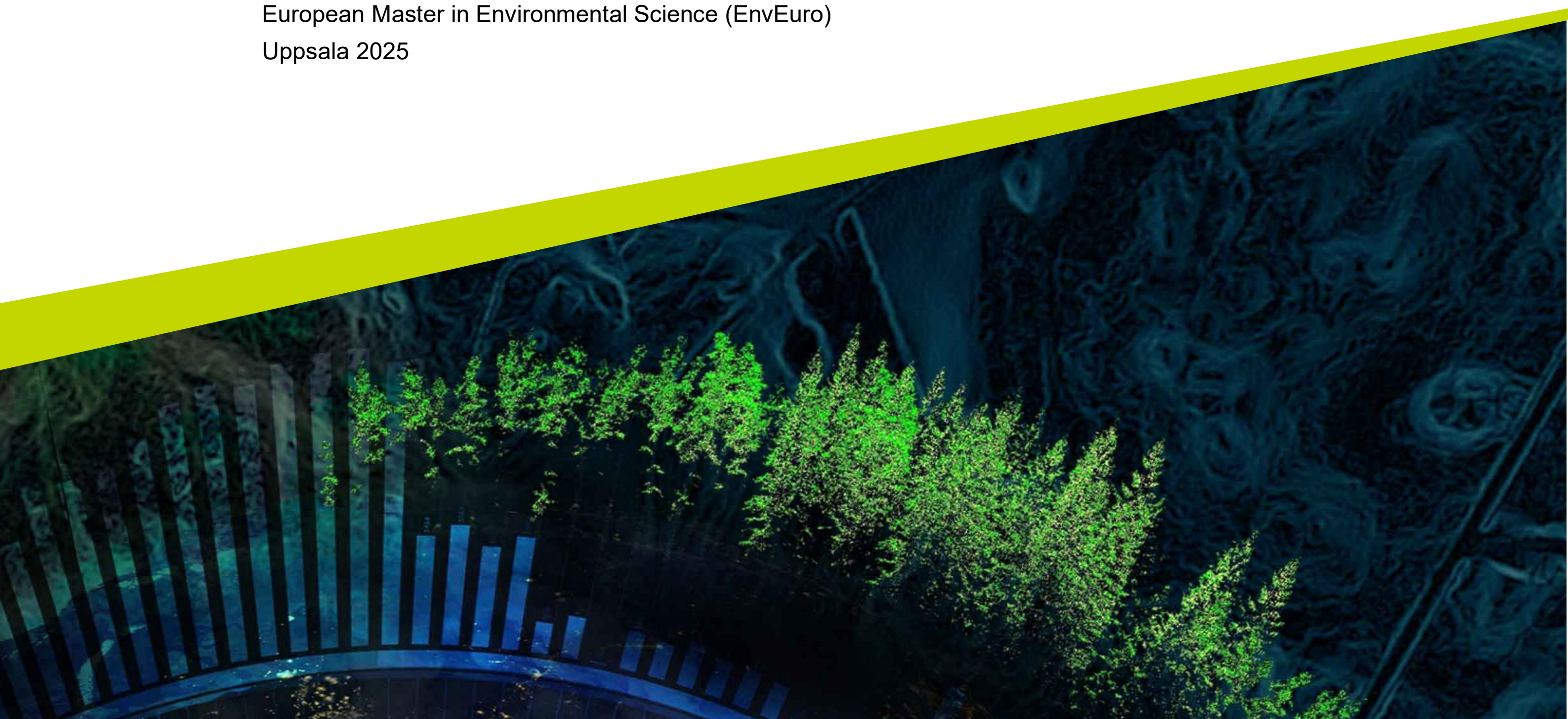

Farmers' Perceptions and Awareness of Climate Change Adaptation Strategies in Local Agricultural Practices: A Case Study in the Badulla District, Sri Lanka

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Abstract

Climate variability poses a growing challenge to smallholder farming systems in Sri Lanka, particularly in the Uva Province. This study examined farmer perceptions, awareness, and adaptation responses to climate change in the Badulla District through a survey of local farmers complemented by interviews with key stakeholders from the Provincial Department of Agriculture.

The findings revealed that farmers are generally well aware of climate change, with their understanding shaped largely by mass media and, to a lesser extent, by extension services, schools, and print media. Most farmers perceive climate change as being driven by both human and natural causes, and they frequently associate it with locally experienced impacts such as irregular rainfall patterns and declining water availability. Education emerged as an important factor influencing awareness, with better-informed farmers demonstrating stronger recognition of climate risks. Adaptation strategies were primarily low-cost, experience-based measures such as crop diversification and adjustments to planting and harvesting schedules. More resource-intensive approaches, including the use of improved varieties, mulching, and water-harvesting practices, were adopted less frequently. Farmers generally expressed only moderate confidence in the effectiveness of these strategies, reflecting limitations in both knowledge and resources. Key barriers included inadequate access to information, limited financial capacity, and insufficient technical support.

Insights from interviews highlighted that while farmers rely strongly on personal observation and practical experience, they tend to resist unfamiliar or knowledge-intensive practices. Although institutional support, mainly from the Department of Agriculture, has been significant, many farmers remain underserved due to gaps in outreach, communication, and the adoption of decision-support tools such as the national Crop Calendar. Overall, the study emphasizes the need to strengthen climate communication strategies, tailor interventions to farmers' education levels, integrate financial and technical support, and improve institutional outreach. Such measures are crucial to translating awareness into effective adaptation and building resilience within local agricultural practices.

Keywords: climate change adaptation, farmer perceptions and awareness, agricultural resilience, institutional barriers, Sri Lanka

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Thankyou

Sachintha Hansamali

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Abbreviations

Abbreviation	Description
ADA	Assistant Director of Agriculture
AI	Agriculture Instructors
ASC	Agrarian Service Centers
CSIAP	Climate Smart Irrigated Agriculture Project
DSD	District Divisional Secretariats
GDRP	General Data Protection Regulation
GND	Grama Niladhari Divisions
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-governmental organizations
PMT	Protection Motivation Theory
SD	Standard deviation
TPB	Theory of Planned Behaviour

1. Introduction

1.1 Climate Condition of Sri Lanka

Sri Lanka is an Indian Ocean tropical island southeast of the Bay of Bengal, with average temperatures that range from 17°C in the central highlands to 27°C in the lowlands. The island's rainfall distribution is controlled by two monsoons: southwest and northeast, which prevail from April to September and October to March, respectively (Siriwardana et al. 2019). The overall land area of the country is 65,610 km2, including 2,905 km2 of inland waterbodies. The maximum width from east to west is 240 kilometres, while the length from north to south is 435 kilometres (Marambe et al. 2015) .

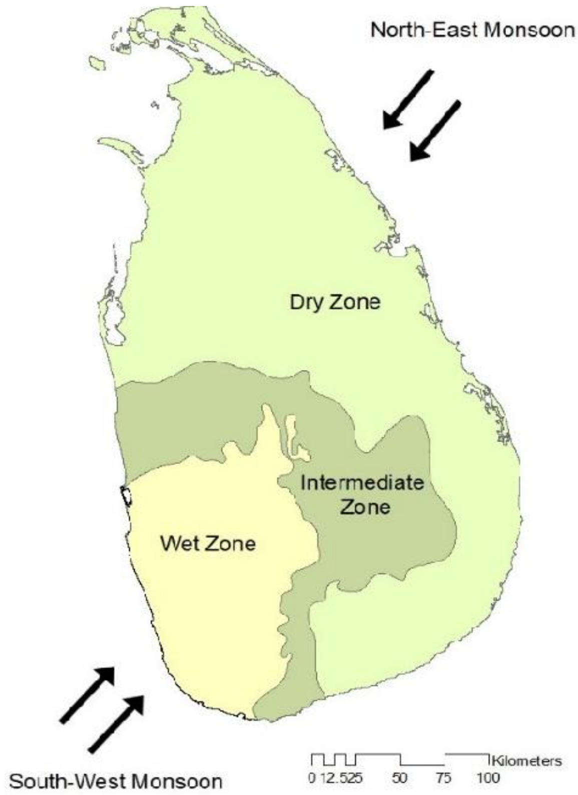


Figure 1. Yakandawala (2023), Three major climatic zones (wet, intermediate and dry) and two monsoons (North-east and South-west) of Sri Lanka.

Climate change has emerged as one of the most significant issues of the 21st century, with far-reaching impacts on agriculture, water, ecosystems, and human livelihoods globally (Esham & Garforth 2013). In developing nations like Sri Lanka, where agriculture is the backbone of rural economies, even minor alterations in climatic patterns have far-reaching socio-economic consequences. As mentioned above, Sri Lanka has a tropical monsoonal climate, dominated to a great extent by two big monsoons the Southwest monsoon (May–September) and the Northeast monsoon (December–February), with intervals between the two monsoons adding additional precipitation (Department of Meteorology, Sri Lanka 2023). However, over the past few years, climatic irregularities in the shape of prolonged dry seasons, off-season rain, increased frequency of off-season weather occurrences, and increased temperatures have been observed (Eriyagama et al. 2010)

1.2 Overview – Badulla District

Badulla District is located in the Uva Province of Sri Lanka and comprises an area of 286,100 hectares. It is one of the most geographically diverse districts of Sri Lanka, comprising highlands, midlands, and lowlands, making it ecologically wealthy and agriculturally fertile. The district lies between latitudes 6° 47' and 7° 03' N and longitudes 80° 43' and 81° 07' E. It is surrounded by the districts of Nuwara Eliya, Monaragala, Ampara, and Matale(Jayatissa & Hossain 2010).

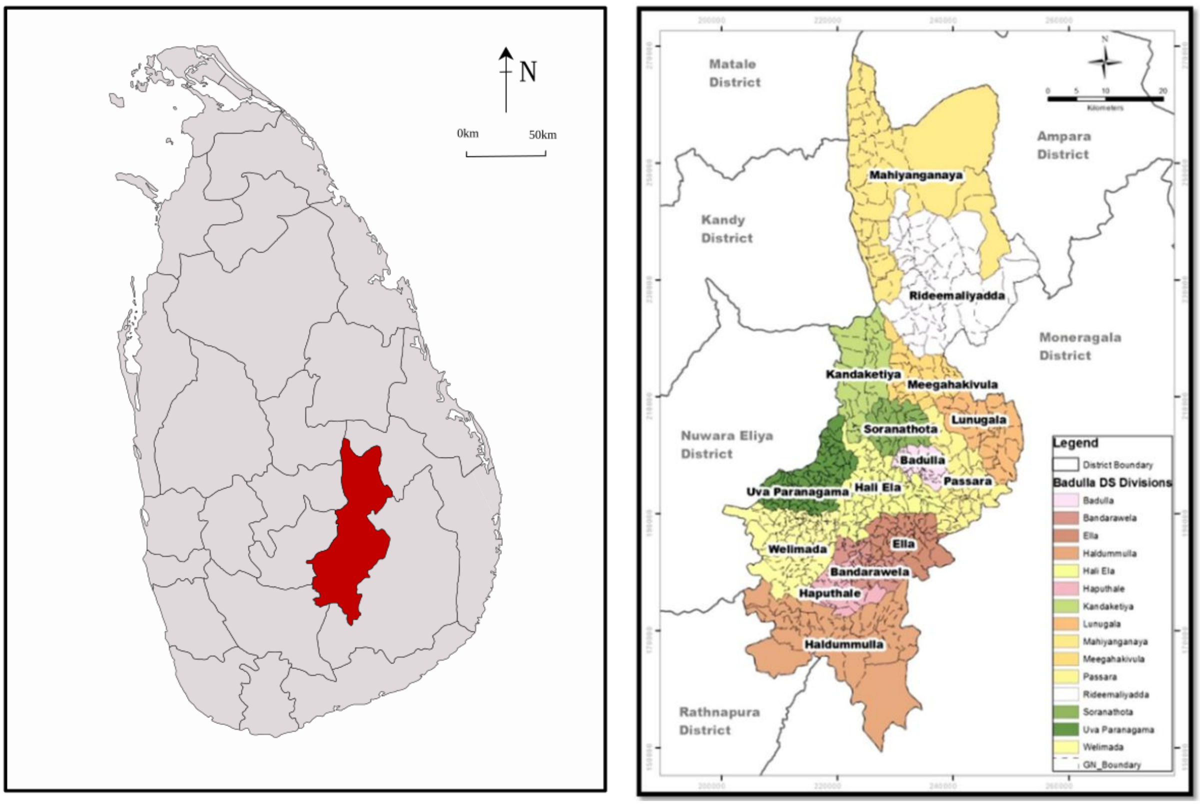


Figure 2.Map Of Badulla,2024 District (https://commons.wikimedia.org/wiki/File:Badulla_district.svg)And Administrative boundaries of Badulla District (https://www.researchgate.net/figure/Administrative-boundaries-of-Badulla-District_fig1_3551863172)

The Badulla district Divisional Secretariats(DSD), 15 in number, and further subdivided into 567 Grama Niladhari Divisions (GND), are directly under the jurisdiction of the District Secretary. 1,991 villages come under the control of these GNDs. Land area distribution among the 15 DSD. Local administration pattern is reflected by 14 Pradesiya Sabhas, 2 Urban Councils, and 1 Municipal Council. Further, there are 180 tea estates in the district(Jayatissa & Hossain 2010)

1.2.1 Climate and Agro-Ecological Zones

Badulla experiences a tropical monsoonal climate with clearly demarcated wet and dry seasons, which are controlled by both the Southwest and Northeast monsoons. The average annual rainfall ranges from 1,250 mm in the low country to over 2,500 mm in the central highlands, and the annual average temperature ranges from 16°C in the highlands to 28°C in the low country (Dharmasena 2014). These climatic variations place the district in several agro-ecological zones, i.e., Up-country Wet Zone (WU2), Intermediate Zone (IM1), and Dry Zone (DL1b), making it suitable for a wide range of crops. (Department of Meteorology, Sri Lanka 2023)

1.2.2 Soil Types

The diversified nature of Badulla topography is favorable for its diversified soil profile, which has a significant bearing on crop selection and cultivation practices. Major soil types are, (Dharmasena 2014).

- Red-yellow podzolic soils in the hill country (Haputale and Bandarawela), suitable for tea, vegetables, and minor export crops
- Reddish-brown earths, found in intermediate elevations, are moderately fertile and extensively cultivated with pulses and vegetables
- Valley and plain alluvial soils (e.g., Mahiyanganaya), cultivated primarily with paddy
- Grumusols and lithosols in poorly drained or shallow rocky terrain, rendering them hard to utilize for further cultivation (Moormakn & Panabokke 1961)

1.2.3 Land Use Patterns

Badulla District land use patterns are determined by its topography and agrarian economy (Dharmasena 2014).

- Agricultural land utilizes nearly 47% of the total land area, both estate plantations and smallholder farms (Department of Agriculture, Sri Lanka 2023).

- Tea plantations, which are concentrated in Haputale and Bandarawela, cover the highlands, and paddy cultivation dominates the lowlands such as Badulla and Mahiyanganaya.
- Forest cover (approximately 30%) includes the Gal Oya National Park and parts of the Maduru Oya forest reserve, which also supports the indigenous Veddah people.
- Urbanization and infrastructure development are focused on Badulla town, Ella, Hali-Ela, and Welimada, and are spreading increasingly.

1.2.4 Demographics

The population of Badulla District, according to the latest figures, is approximately 886,000 with an almost equal gender ratio (49.6% male, 50.4% female). About 350,612 individuals are under the age of 18, indicating a youthful population structure. The district is predominantly Sinhalese (72.5%) with a significant proportion of Indian Tamils (18.2%) who reside in the estate sectors. Muslims and Sri Lankan Tamils make up the remaining 10%, and there are around 1,800 Veddah people (nearly 350 families) in the settlements in the forests near Maduru Oya (Jayatissa & Hossain 2010).

It comprises over 219,300 households, a workforce of 414,786, and an unemployment figure of approximately 24,299. It stands at an average population growth rate of 0.39% annually, and with increasing population pressure, its land-to-person ratio has decreased to 0.35 hectares per person, imposing constraints on land availability for agriculture (Dharmasena 2014; Jayatissa & Hossain 2010).

1.2.5 Agricultural Economy and Climate Vulnerability

Agriculture is the main industry of Badulla, giving people a good income and a way to make a living. This districts main crops are tea, paddy, vegetables such as carrots, leeks, and beans, maize, ginger, turmeric, and a variety of fruits. Despite its lush soils and abundant rainfall, the district is becoming increasingly vulnerable to climate change (Shimola & Krishnaveni 2013). These effects are evident in unpredictable rainfall and droughts, which disrupt agricultural cycles, soil erosion and landslides on hill slopes, water scarcity during dry seasons, and insect and disease outbreaks induced by temperature and humidity fluctuations. Rainwater collecting, crop diversification, and terracing are traditional coping techniques among Badulla farmers; nevertheless, growing climate uncertainty requires more awareness and scientifically supported adaptation strategies (Shimola & Krishnaveni 2013).

Farmers are responding to climate change through different means, such as crop diversification, shifting planting times, water management techniques, and growing drought-tolerant varieties of crops.(Ricart et al. 2023). All these approaches, however, largely depend on the level of farmers' awareness and understanding of the risks of climate change(Esham & Garforth 2013). Adaptation strategies with less knowledge and resources may not be as effective in remodeling their practices and may result in decreased productivity, hence threatening food security in the region (De Zoysa & Inoue 2014).

There are gaps in the knowledge and perceptions of farmers on issues of climate change, even though there are obvious needs for climate change adaptation in agriculture. This mostly occurs due to a lack of access to reliable information, dependable support services, and enough resources to put adjustment strategies into action. This depends upon the physical and financial viability of these measures and how much the farmers are aware of and ready to change their farming methods (Marambe 2020). These are the major keys in determining how successful adaptation plans will be accommodated in the Badulla District. Accordingly, understanding the perception of climate change by farmers and identifying barriers they face in accessing climate information and resources are imperative to developing effective adaptation strategies (Uva Provincial Department of Agriculture 2023).

This study was carried out to assess the level of awareness of climate change, perceived impacts on agricultural practices, and adaptation strategies implemented by farmers in the Badulla District. By assessing farmers' perception, the actual challenges faced by them can be understood, and the strategies that would be most beneficial in developing agricultural resilience may be proposed (Hussein 2024). It will also help in establishing the socio-demographic factors, such as age and education level, that determine farmers' climate change awareness (Bibi & Rahman 2023). The findings will be important to policy implementers at the Ministry of Agriculture Services, Agrarian Services, etc., in formulating and providing more focused and appropriate climate adaptation support for farming communities through agricultural extension services and local organizations.

1.3 Research Objectives

This study aims to:

1. To evaluate the level of awareness and understanding of climate change among farmers in a specific region, and to identify the adaptation strategies they employ in response to climate variability.

2. Analyze the influence of demographic factors (age, education, farming experience) on climate change awareness and the success of adaptation measures.

3. Identify the role of institutional support mechanisms, such as agricultural extension services and access to reliable climate information, in shaping adaptation strategies.

1.4 Research Questions

1. How do farmers perceptions and awareness of climate change influence the adoption of adaptation strategies in agriculture in the Badulla district?

2. What environmental and demographic factors affect the effectiveness of farmers' adaptation strategies in local agriculture?

3. How do socioeconomic and institutional factors impact farmers' ability to adapt to climate change?

2. Background

2.1 Introduction to Climate Change and Agriculture

Climate change has been widely recognized as a significant threat to global agricultural systems, particularly in developing countries. Rising temperatures, changes in precipitation patterns, and increased frequency of extreme weather events adversely affect crop yields and food security (Bibi & Rahman 2023; Jatav et al. 2025). In Sri Lanka, agriculture remains a major economic sector, making it particularly vulnerable to climate-induced changes (Esham & Garforth 2013). The need for effective adaptation strategies has become more pressing as farmers face unpredictable weather conditions that threaten their livelihoods (Akhtar et al. 2018).

Research in Sri Lanka highlights both the challenges and strategies related to climate adaptation. According to Gnanasubramaniam and Hemachandra (2020) analyzed the effectiveness of farm-level adaptation practices in Sri Lanka, especially in the dry Zone, showing a clear gap between policy objectives and farmers actual behavior. Similarly, Sithumini et al. (2020) found that farmers with strong social networks and better access to climate information were more successful in adapting. Policy responses have already been introduced to support these efforts (Dasandara et al. 2023). Esham and Garforth (2013) further categorized adaptation measures into five groups, including crop diversification and irrigation management, while emphasizing the importance of non-climatic factors. More recently, Nagamuthu (2024) stressed the need for sustainable water management, and Alahacoon et al. (2021) highlighted regional vulnerabilities, especially in Northern Sri Lanka.Futher, Alahacoon et al. (2021) developed a satellite-based platform for monitoring meteorological and agricultural droughts in Sri Lanka for enhanced agricultural sustainability. Even though the study is primarily focused on drought monitoring, indirectly, it assists with climate change adaptation by providing essential information that can be used to make effective water resource management and agriculture planning decisions. The approach conforms to the need for an informed decision-making strategy to combat climate variability.

The way that smallholder farmers respond to climate change adaptation is greatly influenced by their perspectives. According to Diyawadana et al . (2016), the vast majority of farmers in the Hakwatuna-oya large irrigation project noticed observable alterations in climatic patterns, including rising temperatures and falling precipitation. 61% of farmers have adopted various coping measures, including employing drought-resistant crops, adjusting planting seasons, and producing short-duration rice varieties, as a direct result of these perceived changes. But according to the report, 39% of farmers had not put any adaptation

measures into place, primarily because they lacked institutional support, financial resources, and knowledge. Notably, it was discovered that both climate perception and adaptability were substantially connected with household members' educational attainment and access to agricultural extension services.
Given these insights, my study examined climate adaptation in Sri Lanka with a focus on farmer perceptions and awareness, adaptation strategies, and the role of social and institutional support and barriers.

2.2 Farmer Perceptions and Awareness of Climate Change

Farmer awareness and perception of climate change play a crucial role in their adaptation responses. Studies indicate that while many farmers acknowledge climatic variability, their understanding of its causes and long-term consequences is often limited (Nagamuthu 2024). Gnanasubramaniam and Hemachandra (2020) highlighted that adaptation strategies at the farm level depend on perception and awareness, emphasizing the divergence between policy-driven adaptation measures and on-the-ground farmer responses. Similarly, Sithumini et al.(2020) found that farmers who were exposed to climate change information and had strong social networks were better equipped to implement adaptation measures.

Esham and Garforth (2013) further categorized adaptation measures into five key groups: crop management, land management, irrigation management, income diversification, and cultural practices. While these measures are widely recognized as effective, Sithumini (2020) noted that socio-economic factors, such as financial constraints and educational background, significantly affect their adoption

Agrawal (2008) argued that local institutions play a pivotal role in shaping adaptation responses by mediating access to resources and facilitating knowledge transfer. This aligns with the findings of Eriksen et al. (2015), who emphasized the role of social structures and policy frameworks in determining adaptive capacity. Leiserowitz et al. (2013) further highlighted that public perception and trust in climate science influence adaptation decisions, with misinformation and political ideology often acting as barriers to effective responses. Diyawadana et al. (2016) highlight farmers perception-driven adaptation to climate change, emphasizing socioeconomic influences. This aligns with assessing adaptation strategies in Badulla, revealing regional variations in farmer awareness and coping mechanisms. Adaptation at the local level is most effective when institutions act as intermediaries between communities and external support, including financial, informational, and technological resources(Agrawal 2008).

When comparing these findings, it becomes evident that farmer adaptation is not solely driven by climate awareness but is also shaped by institutional support, financial capability, and socio-cultural influences. This study will explore how these factors interact to determine the effectiveness of adaptation strategies in Sri Lanka, contributing to a deeper understanding of climate adaptation at the micro-level.

2.3 Climate Change Impacts on Agriculture

The impacts of climate change on agriculture vary depending on the region and crop type. In Sri Lanka, tea plantations, rice paddies, and vegetable farms are highly sensitive to climate variations (Navaratne et al., 2019). Erratic rainfall patterns, temperature fluctuations, and prolonged droughts have led to yield reductions and increased production costs. Pathiraja et al. (2017) further indicate that agriculture-dependent economies in South Asia face serious economic losses due to climate-induced crop failures. This finding underscores the vulnerability of rural livelihoods in the region and supports broader evidence that climate change threatens both household food security and national economic stability. Esham and Garforth (2013); Nagamuthu (2024) emphasized that smallholder farmers in Sri Lanka are particularly vulnerable due to their dependence on rain-fed agriculture, which leaves them highly exposed to extreme weather events. Consistent with this, Sithumini et al. (2020) found that unpredictable monsoonal patterns significantly undermine household food security in the Dry Zone.. Research by Agrawal (2008) highlighted that the institutional capacity to provide timely climate information and resources plays a crucial role in mitigating these. Eriksen et al. (2015) further stressed that adaptation to climate change should be integrated into national development policies to ensure long-term resilience. This perspective highlights the importance of policy coherence, complementing findings from Sri Lanka that stress the gap between policy design and farmer practices

Comparing these findings, it is evident that while climate variability threatens agricultural productivity, its effects are exacerbated by socio-economic and institutional constraints. Addressing these barriers through improved irrigation infrastructure, access to climate-smart agricultural techniques, and farmer education can enhance resilience. This study will assess these impacts specifically in Badulla, identifying localized solutions for climate adaptation in the agricultural sector.

2.4 Adaptation Strategies in Agriculture

Numerous proofs from the literature about various farm-level adaptation strategies can be found in the literature. As an example, Farmers have adopted various strategies to cope with climate variability, and they have been using some agricultural techniques since ancient times that may help them minimize the adverse effects of climate change(Chithranayana & Punyawardena 2014).
Studies indicate that farmers in Sri Lanka's Dry Zone have developed a variety of adaptation strategies to manage climate-related stress. Esham and Garforth (2013) found that many of these practices focus on minimizing the risk of dry spells during key production periods, reflecting the central role of water management in sustaining agricultural livelihoods. According to his research, the techniques include altering planting schedules, using drought-tolerant crop types, and reducing irrigation depth through methods like micro-irrigation. Farmers have also introduced crop diversification, mulching, the utilization of shade trees, and reducing the cultivation season as significant resilience strategies. Williams and Carrico (2017) underline that changing planting schedules, rotating crops, and choosing fast-growing or more resilient crop types are critical to lowering climate-related risks and assuring more consistent agricultural outcomes. Farmers have also adopted a new paddy transplantation technique known as the "parachute method," which uses less water and results in higher crop yields in Sri Lanka (Thilakasiri et al. 2015).
While these strategies have been widely studied, their effectiveness and adoption rates in specific regions like Badulla require further investigation. Gnanasubramaniam and Hemachandra (2020) noted that despite the availability of adaptation techniques, many farmers in Sri Lanka face financial and institutional barriers to implementation. Sithumini et al. (2020) highlighted that farmers with greater exposure to extension services and social networks were more likely to adopt adaptation measures.
Agrawal (2008) emphasized the role of local institutions in facilitating climate adaptation, particularly by mediating access to resources and knowledge. Building on this, Esham and Garforth (2013) argued that adaptation strategies should be embedded within broader development frameworks to ensure long-term sustainability. Comparing these perspectives, it is clear that while farmers employ various adaptation strategies, their effectiveness is influenced by socio-economic, institutional, and environmental factors. This study will explore how these factors interact in Badulla District, assessing the success of existing adaptation measures and identifying opportunities for improvement.

2.5 Barriers to Climate Change Adaptation

According to past research, several factors can affect farmer climate adaptation. That can be classified as demographic factors, Environmental, socioeconomic factors, and mainly institutional management. Despite the availability of adaptation strategies, several barriers hinder their implementation (Agrawal 2008; Vijitha et al. 2022; Williams & Carrico 2017).
A range of demographic and socio-economic factors has been identified as influencing farmers capacity to adapt to climate change. These include the gender, age, education level, household size, and occupation of the household head(Herath & Thirumarpan 2017; Uy et al. 2015). Additional factors such as poverty, land ownership, farm size, credit access, off-farm employment, and income level have also been shown to play a critical role. Udmale et al. (2014) furthermore show that limited assets, inadequate technical skills, and livelihood insecurity can significantly constrain adaptation efforts. Burchfield and Gilligan (2016) address these barriers is crucial for improving farmers' resilience to climate change.

2.6 Institutional Factors Impacting Farmers Adaptation to Climate Change

Climate change has a significant impact on the world's agricultural system, particularly in developing countries like Sri Lanka, where agricultural communities are extremely vulnerable to changes in the weather (Pathiraja et al. 2017). Apart from the demographic and Socioeconomic factors, mainly institutional factors influence farmer awareness, perceptions, and adaptation strategies, which in turn impact their ability to adjust to such changes(Gnanasubramaniam & Hemachandra, 2020). This section examines the research on how these factors have impacted farmers' ability to adapt to climate change.

Every governance system is responsible for risk management and also for achieving climate risk resilience; farmers need adapted institutional services (Khan et al. 2023). Farmers' adaptation decisions are greatly influenced by efficient institutional support, such as agricultural extension services. Climate adaptation is made practicable by effective government policy. Falco et al. (2011) discovered that by lowering financial risks, insurance programs, and agricultural subsidies greatly improve farmers' ability to adapt. Similarly, Below et al. (2012) stress that smallholder farmers' resilience is enhanced by national adaptation measures, including early warning systems and the distribution of drought-resistant seeds. However, their efficacy is frequently constrained by poor policy implementation and a lack of locally relevant solutions (Adger et al. 2009). By combining resources and expertise, community-based organizations like farmer cooperatives increase adaptive potential. According to Agrawal (2008)Group efforts enhance access to cooperative irrigation systems and weather forecasts. However, disadvantaged groups may be marginalized by unequal power dynamics inside institutions (Eriksen et al. 2015).

Resilient farming methods are being promoted in Sri Lanka by government programs, including the Climate Smart Agriculture program(Ministry of Agriculture 2020). According to Food and Agriculture Organization of the Uited Nations mention that the Sri Lankan agricultural system operates through a three-tier institutional framework, comprising the first one is the Departments of Agriculture, Agrarian Development, Animal Production & Health, and Fisheries & Aquatic Resources are the agricultural institutions which manage regulation, research, extension, and certification at the national level. Same included in the Departments of Agriculture, input-supply services, and credit/insurance institutions are the remain two institutional framework. Farmers' organizations allow farmers to express their interests and concerns by acting as representative entities at the district, provincial, and national levels (via federations).

In order to spread climate-smart agriculture practices, extension services are essential. Farmers who have access to extension services are more likely to use better irrigation practices and crops resistant to drought (Deressa et al. 2009), On the other hand, knowledge transfer can be hindered by inadequate funding for extension initiatives and weak institutional frameworks(Maddison, 2007). According to Feder and Feeny (2022), farmers who participate in decision-making through participatory extension programs are more likely to adopt adaptive strategies.

Credit, insurance, and subsidy programs that date back to the 1970s are examples of Sri Lanka's institutional support for agriculture. Crop/livestock insurance, farmer pensions (1995), and the 1986 Rural Credit Scheme are important programs (Marambe et al. 2017). Programs for land redistribution (like Swarnabhoomi and Jayabhoomi) and irrigation development (like Mahaweli) were designed to increase production. Since 1962, fertilizer subsidies have greatly raised paddy yields; however, changes currently prefer cash handouts, such as SLR 25,000/ha. Agriculture and poverty reduction are linked through price subsidies, research, and extension services that further strengthen farming livelihoods (Marambe et al.2017). According to above mentioned research, institutional factors significantly shape farmers' adaptation strategies. Strengthening policy frameworks, improving extension services, ensuring financial access, securing land tenure, and fostering social networks are essential for enhancing climate resilience. Future research should explore institutional innovations that address equity and inclusivity in adaptation planning.

2.7 Gaps in the Literature

There are still important unanswered questions about climate change and its effects on agriculture despite a wealth of studies. Although numerous studies have examined the impacts of climate change on agriculture in Sri Lanka, many focus on broader national or regional patterns. As a result, there is still limited evidence on localized impacts in specific districts such as Badulla. This highlights the need for more district-level evaluations of both the opportunities and challenges. Furthermore, the relationship between farmers' adaptation choices and demographic characteristics like age, education, and agricultural experience has not been fully investigated. Designing specialized treatments that successfully meet the needs of various farmer groups requires an understanding of how these factors affect climate adaptation behavior. It is essential to comprehend how these factors affect climate adaptation behavior to create customized actions that successfully meet the requirements of various farmer groups.

A comprehensive analysis of the literature highlights the urgent need for localized research on climate adaptation strategies. In order to improve agricultural resilience in Sri Lanka, especially in the Badulla District, better informed policies will be developed by looking into farmers' perspectives, adaptation hurdles, and the efficacy of present solutions. Future studies should combine scientific advice with farmers' perspectives to develop workable and long-lasting adaptation strategies. Policymakers and other stakeholders may increase climate resilience in Sri Lanka's agriculture sector by filling in these gaps and putting more focused and efficient measures into place.

2.8 Theoretical and Conceptual frameworks

This Section outlines the comprehensive theoretical and conceptual framework that underlies this research. It uses Institutional Theory (Scott 1999), A modified version of the Intergovernmental Panel on Climate Change (IPCC) vulnerability framework to examine farmers' adaptation options in Sri Lanka, Badulla District. This integrated approach allows for an assessment of both structural factors on adaptation decisions and the adaptation process itself.

2.8.1 Institutional Theory as Analytical Foundation

Several determinants influence farmers' climate change adaptation, ranging from individual perceptions to institutional systems. Studies consistently confirm that climate change adaptation is a mediation process supported by complexities in relationships between farmers' socioeconomic conditions, support systems at the institutional level, and perceived environments (Agrawal 2008; Gnanasubramaniam Hemachandra 2020).

This study examines Scott (1995) Institutional theory includes three pillars of institutions, which are particularly useful for this study analysis. The regulative pillar examines formal programs and rules; the normative pillar shines light on social expectations and conventional behavior; and the cultural-cognitive pillar exposes deeply embedded understandings and attitudes that influence how farmers comprehend and behave in the face of climate risk.

The use of this theoretical framework is especially relevant in the Sri Lankan context, where agricultural practices are firmly ingrained in social networks, traditional knowledge systems, and institutional frameworks. This study goes beyond individual-level characteristics to examine how broader structures and institutions facilitate or hinder effective responses to climate change by concentrating on the institutional elements of adaptation. This approach is consistent with international studies revealing that successful adaptation is dependent not only on technology solutions but also on the institutional contexts that enable their implementation(Cuevas 2018).

2.8.2 Conceptual Framework

The conceptual framework for this study is based on a modified version of the Intergovernmental Panel on Climate Change (IPCC 2025) Climate Change Vulnerability Framework, adapted to emphasize the role of public perception in shaping adaptation strategies. Figure 3 model of framework showing integrates key elements such as climate change exposure, perception of climate change, and adaptation strategies, adaptive capacity, institutional influence, and resilience outcomes. This structure is designed to reflect how farmers' awareness and beliefs, shaped by their experiences, knowledge sources, and institutional interactions, mediate their response to observed climate impacts (Hussein 2024). It also captures the enabling or constraining role of financial, technical, and informational resources in influencing whether these perceptions translate into the adoption of adaptation strategies (Pathiraja et al. 2017).

Within this conceptual framework, perception functions as both a filter for interpreting environmental change and a driver of behavioural change. Climate exposure informs the perception of risks, which then shapes how farmers evaluate and select adaptive responses. Adaptive capacity and institutional support determine whether perceived strategies are feasible, while the outcomes of adopted practices (e.g., improved resilience or persistent vulnerability) feed back into future perceptions and actions. This model aligns with the data collected through surveys and interviews in the Badulla District, providing a robust foundation for analyzing how local communities perceive and navigate climate change adaptation.

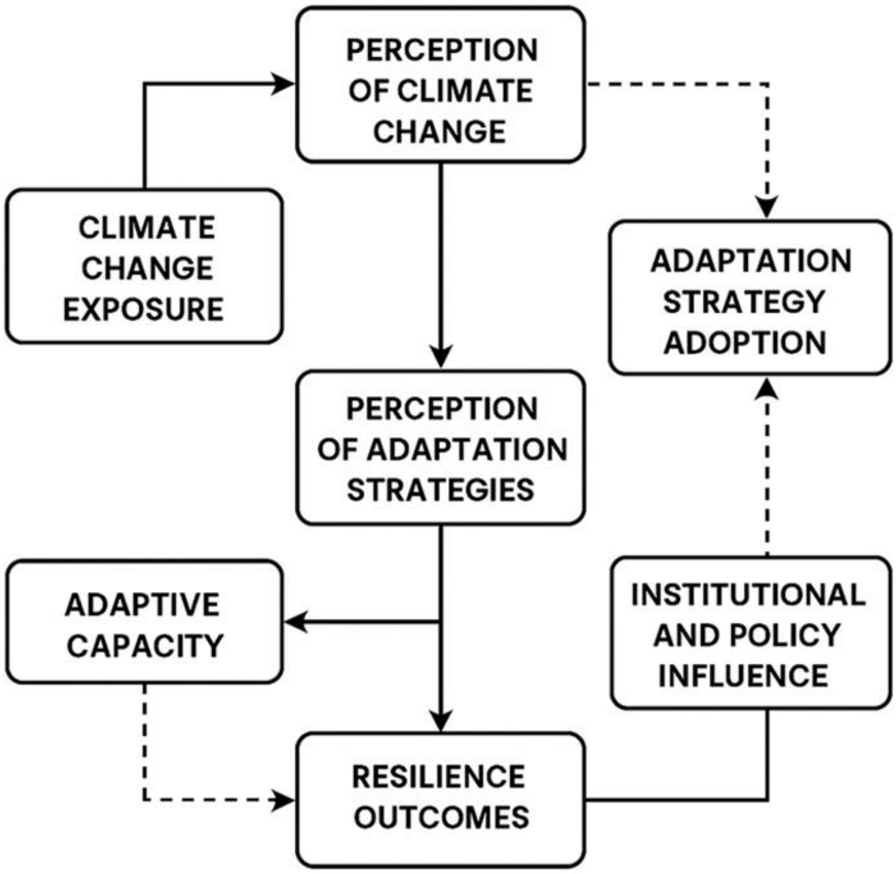


Figure 3. Conceptual Model for Climate Change Adaptation Based on a Modified IPCC Framework,Created by the Author 2025

After a thorough assessment of both Institutional Theory and the IPCC-based conceptual framework, it was clear that, while each delivers useful insights, their combination provides a more solid and comprehensive analytical tool for this study. Institutional Theory excels at understanding the why behind adaptation hurdles, revealing the underlying laws, conventions, and beliefs that shape behavior. In contrast, the conceptual framework effectively maps the adaptation process, charting the journey from climate exposure to resilience outcomes.

Figure 5 showing (Integrated Conceptual Framework Combining Institutional Theory with Modified IPCC Adaptation Model). This figure shows the basic adaptation process (informed by the IPCC framework) as it is established and modified by the three institutional pillars of Institutional Theory (Scott 1995). The pathway goes from Climate Change Exposure to Resilience Outcomes. Crucially, the entire Institutional Environment, which includes the Regulative, Normative, and Cultural-Cognitive pillars, influences and mediates each phase of this process (as indicated by the encompassing arrow), proving that adaptation does not occur in an institutional vacuum. A feedback loop from outcomes to perception emphasizes the dynamic aspect of adaptation, learning, and change.

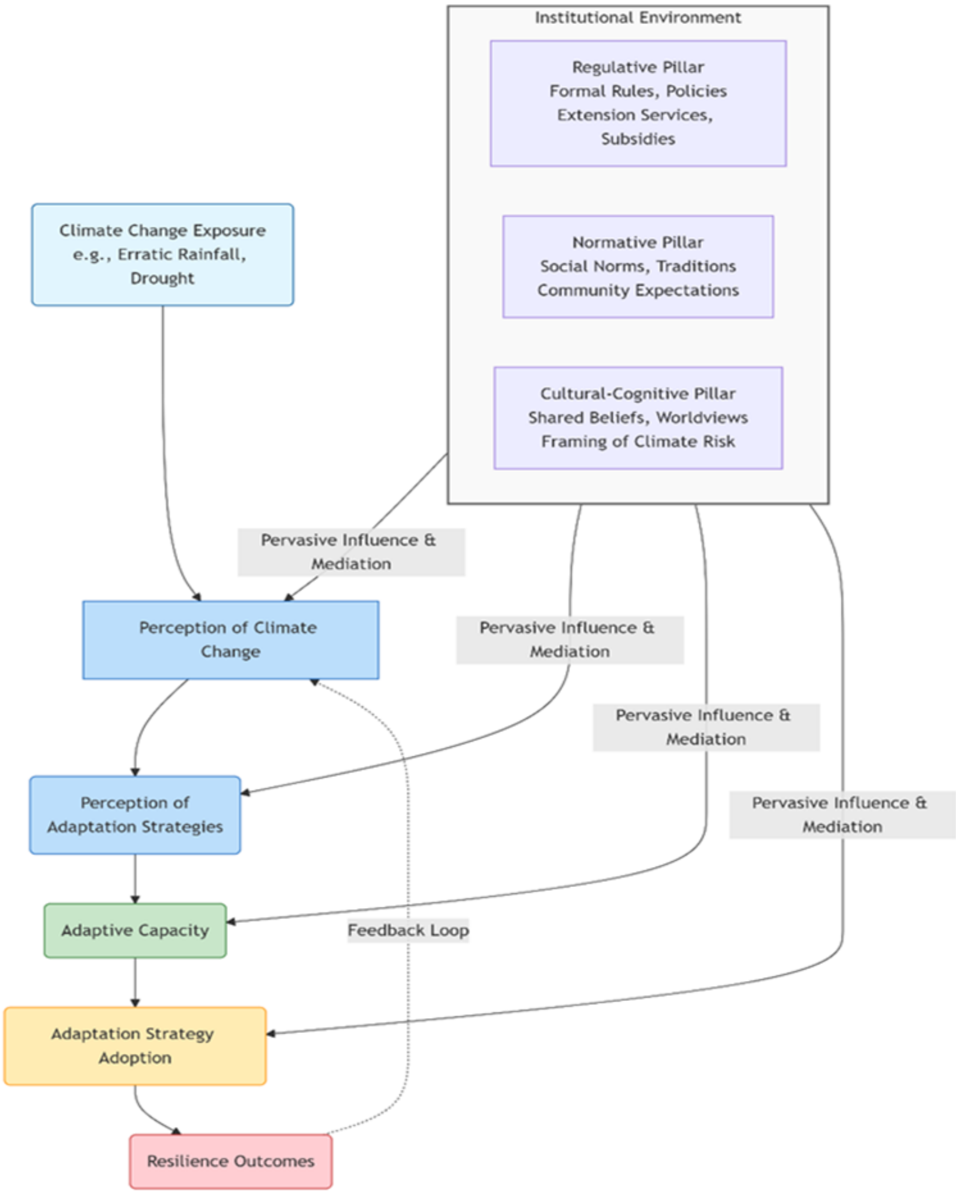


Figure 4.Integrated Conceptual Framework Combining Institutional Theory with Modified IPCC Adaptation Model, Created by the Author 2025

This integrated approach allows for a full analysis that not only describes the actions farmers take but also diagnostically explains how the surrounding institutional environment enables or constrains each step of their adaptation journey, thereby providing a deeper understanding of the systemic determinants of climate resilience in Badulla District.

3. Methodology

This chapter outlines the methodological framework guiding this study, detailing the research design, data collection procedures, and analytical approaches employed. The study adopts a mixed-methods approach, combining quantitative surveys with farmers in Badulla district and qualitative interviews with policymakers to comprehensively analyze farmers' adaptation strategies to climate change in Badulla District, Sri Lanka. The research design is informed by Institutional Theory (Scott 1995), which incorporates conceptual analysis, providing a robust framework for examining how formal and informal institutions shape adaptation behaviors.

3.1 Study Area and Target Population

This study was conducted in the Badulla District of Sri Lanka's Uva Province. The district was selected due to its significance as a key agricultural region, characterized by a diversity of cropping systems and agro-climatic conditions, ranging from the central highlands to the intermediate plains.

Within the district, the first four (04) Assistant Director of Agriculture (ADA) divisions were purposively selected: Bandarawela, Welimada, Mahiyanganaya, and Badulla. This selection was designed to capture the primary agro-ecological and agricultural socioeconomic variability within the district. Bandarawela represents the high-altitude tea-growing region, Welimada the intensive vegetable-growing zone, Mahiyanganaya the paddy-based systems of the dry region, and Badulla serves as a central mixed-agriculture hub.

Subsequently, from each selected ADA division, five(05)ASC Divisions were identified for data collection through consultations with the respective ADA officers(Total 20 ASC divisions) as indicated in Figure 5. The selection criteria for the ASC Division were based on (1) their prominence in the key agricultural activity of that division (e.g., Kappetipola in Bandarawela for tea), (2) accessibility for the research team, and (3) the willingness of local farming communities to participate in the study. This purposive approach ensured that the study sites were information-rich and relevant to the research objectives.

Finally, for each of the 20 selected ASC Divisions, a comprehensive list of active farmers was obtained from the respective ADA Division office.(Appendix 3-Request letter to obtain farmer list) Official permission to access these farmer registries was secured by sending a formal request letter to the Department of

Agriculture, Badulla District, which granted the necessary approval for the study. From each ASC list, a simple random sampling technique was then used to select 26 farmers. This sample size included a buffer of 1 extra farmer per ASC Division to be used as a replacement in case of refusal or unavailability, ensuring the final target sample of 25 completed surveys per village was met. This resulted in a sample of 100 farmers in total.

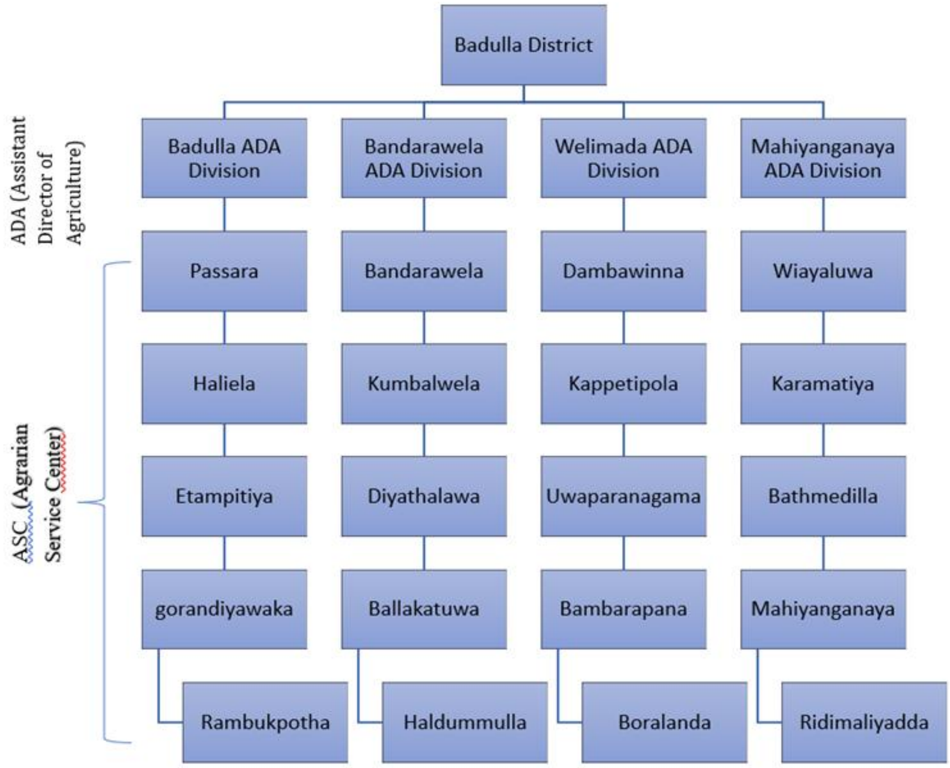


Figure 5. Flow chart of Selection of ASC Divison for data collection, Created by the Author

3.2 Sampling Method and Ethical Considerations

The sampling procedure for this study followed a multi-stage design, as detailed in Section 3.1 (Study Area and Site Selection). In brief, farmer lists obtained from each of the four selected Assistant Director of Agriculture (ADA) division offices served as the sampling frame. A simple random sampling technique was then applied to select respondents from these lists within each chosen village, resulting in a final sample of 100 farmers in total. Before participation, each respondent was presented with a General Data Protection Regulation (GDPR) compliant consent form, which described the study's purpose, data usage, and rights of the participants. Only those who accepted the survey were included in the study. All data were handled anonymously and processed in strict compliance with privacy regulations, ensuring ethical integrity.

3.3 Data Collection Timeline and Enumerator Allocation

The data collection was conducted over ten days by a team of two trained enumerators. To ensure the highest levels of data validity, reliability, and consistency, a strict protocol was designed by me and implemented for this study, and an administered survey technique was used. That protocol is as follows.

Enumerator Training and Allocation

The enumerators were final-year undergraduates from the Department of Export Agriculture, Uva Wellassa University of Sri Lanka, selected for their academic knowledge and familiarity with the local agricultural context. Before fieldwork, they underwent a comprehensive virtual training session conducted by me. This training covered:

- The objectives of the study and the precise meaning of each survey question to avoid misinterpretation.
- Techniques for reading questions aloud in a neutral tone, without leading the respondent or introducing bias.
- Practice sessions on how to record responses accurately and legibly on the printed questionnaires.
- The ethical protocol includes the process of obtaining informed consent and ensuring respondent anonymity.

Each enumerator was assigned to two Assistant Director of Agriculture (ADA) Divisions, ensuring comprehensive coverage of all four study divisions.

Field Protocol for the Enumerator

Data collection followed a daily routine in which one Agrarian Services Centre (ASC) area was covered by each enumerator in a day. Taking the official farmer lists as the sampling frame, they took five farmers in each ASC. For each farmer, the enumerator conducted a personal interview, reading out each question from the printed questionnaire and writing down the farmer's responses exactly by hand. This approach was employed to allow farmers' requests and to attain a 100% response rate without missing data. The protocol also guided enumerators to probe neutrally, for instance, by asking, "Can you tell me more about that?" when the answers were not clear or complete, thereby ensuring response depth without influencing content. In addition, I have added a comment section, and Enumerators were trained to use this section to document any relevant information, explanations, or anecdotes that farmers provided beyond the structured questions.

Remote Supervision and Quality Assurance of the survey

As the principal researcher, I designed and implemented a multi-step quality control protocol from Sweden to maintain data integrity. My remote oversight and coordination of validation procedures consisted of the following:

I required enumerators to send me daily field photographs or scanned versions of the completed paper questionnaires using WhatsApp. This allowed me to carry out daily quality checks on completeness, readability, and data collection consistency.

To ensure a final layer of quality control, I instructed the enumerators to courier all completed physical questionnaires to me in Sweden after finishing the survey. Once received, I personally transcribed all data from the paper questionnaires into a digital database. This hands-on process enabled me to conduct a comprehensive validation and cross-checking of the entire dataset, ensuring its accuracy before analysis.

As I was based in Sweden and unable to be physically present in Sri Lanka during the data collection period, remote monitoring was carried out through daily WhatsApp video calls with the enumerators. These virtual check-ins, conducted on randomly selected days, allowed for effective supervision of the data collection process and provided a clearer understanding of the field conditions. However, a limitation of this approach for me is that the absence of physical presence may have reduced opportunities for direct observation, informal interactions with farmers, and immediate troubleshooting in the field, which could have enriched the data quality and contextual insights.

3.4 Data Collection Methods

A mixed-method approach was adopted to ensure comprehensive data collection. This design was selected to triangulate findings, leveraging the strengths of quantitative data to identify generalizable patterns and qualitative data to provide depth, context, and explanatory insights.

3.4.1 Surveys

A structured questionnaire(Appendix 3) was used to collect quantitative data on adaptation measures, awareness, and perceptions. The questionnaire contained both closed-ended (interval-scale) questions and open-ended ones to capture complementary qualitative insights. The surveys were administered by trained enumerators, who also documented farm practices and environmental conditions through photo evidence.

The data collection process, including enumerator training, the rigorous protocol for researcher-administered surveys, and the multi-step remote quality control procedures implemented from Sweden, is described in detail in Section 3.3. This approach, which included daily digital debriefs and the physical transfer of completed questionnaires, was essential for ensuring the consistency, accuracy, and ultimate reliability of the data in this study.

3.4.2 Key Informant Interviews

To gain institutional and policy-level insights, semi-structured interviews were conducted with four key informants from the Provincial Department of Agriculture. Participants were purposively selected based on their expertise and institutional roles directly related to climate adaptation programming and farmer outreach (See Table 1).

The development of the interview questionnaire was guided directly by the conceptual framework and theoretical approach. The questions were explicitly designed to explore the key constructs and relationships outlined in the framework and to examine the applicability of the institutional theory in an institutional context.

Table 1.Selected key informants and their position

The key informants	Position	Place
KI- 1	Deputy Director of Agriculture	Provincial Department of Agriculture
KI -2	Deputy director Agricuture(Training)	Provincial Department of Agriculture
KI- 3	Assistant Director (Extension Division)	Provincial Department of Agriculture
KI -4	Agriculture instructor (AI)	Provincial Department of Agriculture

An interview guide was developed around key themes derived from this foundation: institutional strategies for climate awareness, perceived barriers to farmer adaptation, the effectiveness of existing programs, and recommendations for policy improvement. Before each interview, verbal informed consent was obtained. Interviews were conducted in Sinhala via WhatsApp, lasted approximately 45 minutes, and were audio-recorded with permission for accuracy. Subsequently, the recordings were transcribed and then translated into English for analysis. Thematic analysis was used to identify and report patterns within the qualitative data. Confidentiality was maintained by using generic identifiers (e.g., KI-1, KI-2) in all reporting

3.5 Data Analysis

By exploring farmers' awareness, perception, and effectiveness of climate change adaptation in Sri Lanka, a mixed methods design provides a solid platform for comprehending the quantifiable trends and deeper contextual meanings. As (Creswell 2004) stipulates, mixed methods research involves the deliberate integration of quantitative and qualitative data within a single study to assist in understanding complex social phenomena more fully. This approach is particularly valuable in field-level farm studies, where raw statistical information cannot truly reflect local knowledge and adaptive practice. By combining these strategies, the research not only identifies trends in farmer response but also identifies the logic of their practice and thus arrives at more effective and locally relevant adaptation. In this research mixed-methods approach was employed to combine both quantitative and qualitative analyses to achieve the study objectives

3.5.1 Quantitative Data Analysis

Collected survey data from 100 farmers were coded, entered into a spreadsheet(Appendix 2), and analyzed using SPSS (Version 29)(Appendix 2). The analysis utilized both descriptive and inferential statistical techniques to explore farmers' awareness, perceptions, and adaptation strategies related to climate change. Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarize demographic variables, perceived impacts of climate change, and the adoption of adaptation strategies. Inferential statistics were used to explore relationships between variables. Cross-tabulations with Chi-square tests examined associations between socio-economic characteristics (e.g., education, farming experience) and the awareness/adoption of climate-resilient practices. Since the data from Likert-scale questions were ordinal, non-parametric tests (Kruskal-Wallis) were employed to compare perceptions of effectiveness and barriers across different demographic groups.

3.5.2 Qualitative Data Analysis

Qualitative data from open-ended survey responses and key informant interviews were analyzed using thematic analysis following the systematic approach of Braun & Clarke (2006).
The analysis proceeded through the following phases:

1. Familiarization with the Data: I have repeatedly read the translated interview transcripts while listening to the audio recordings to ensure accuracy and immerse myself in the data, noting down initial ideas.
2. Generating Initial Codes: Significant phrases, sentences, or paragraphs from the transcripts were systematically labeled with descriptive codes that captured key concepts. This process was conducted manually. For example, the statement "We don't call it 'climate adaptation', we say, 'This will improve your yield.'" was coded as "Framing advice pragmatically" and "Avoiding technical jargon". The code "Financial barriers" was generated from segments discussing the unaffordability of technology despite subsidies.
3. Searching for Themes: Then, I initial list of codes was collated and examined to identify broader patterns of meaning. These codes were grouped into potential themes. For instance, codes such as "Framing advice pragmatically", "Avoiding technical jargon", and "Limited scientific understanding" were clustered together to form the preliminary theme "Practical awareness amidst limited scientific understanding".
4. Reviewing Themes: This phase involved a two-level review. First, the coded data extracts for each potential theme were reviewed to check if they formed a coherent pattern. Second, the entire dataset was re-read to ensure the themes accurately represented the meanings evident in the data. This iterative process led to the refinement of some themes and the collapse or separation of others.
5. Defining and Naming Themes: Each theme was clearly defined and given a concise, informative name that captured its essence. The scope and content of each theme were outlined to avoid overlap.
6. Producing the Report: The final step involved selecting vivid, compelling extract examples from the transcripts to illustrate each theme in the results section, weaving them into a narrative that tells the story of the data.

Coding framework deliberately guided by the Integrated Conceptual Framework, combining Institutional Theory with Modified IPCC Adaptation Model to ensure alignment with core research concepts such as institutional support, perceived barriers, and adaptation efficacy. The interpretation of these themes was further informed by the theoretical approach, specifically institutional theory, which provided a lens for understanding underlying motivations and behavioral responses. This structured analytical process allowed for a nuanced exploration of both farmer perspectives and institutional insights, ensuring that the qualitative findings contributed depth and context to the quantitative results.

4. Result

4.1 Quantitative Data

4.1.1 Demographic and Socioeconomic Information

This section presents the findings from the analysis of data collected from 100 farmers across the Badulla District. The results are structured to first describe the socio-demographic characteristics of the respondents, followed by their awareness and perceptions of climate change, the adaptation strategies they employ, and the barriers they face. The demographic and socioeconomic characteristics of the respondents are summarized in Table 2. The results indicate a sample comprised primarily of middle-aged and experienced farmers.

The mean age of respondents was 51.51 years (SD = 9.67), with a range from 30 to 80 years, suggesting a predominantly older workforce engaged in agriculture in the region. Farmers also reported substantial experience, with an average of 22.96 years (SD = 12.23) in farming, indicating long-term exposure to climatic changes and agricultural practices.The average household size was 4.04 members (SD = 1.04), which is consistent with typical rural family structures in Sri Lanka. Monthly agricultural income showed considerable variation, ranging from LKR 5,000 to LKR 70,000, with a mean of LKR 32,707.07 (SD = LKR 15,278.54). One non-response was recorded for the income variable (N=99). The skewness and kurtosis values for all variables fell within acceptable limits (±1.0), indicating a reasonably normal distribution of the data.

Table 2 Descriptive Statistics of Key Demographic and Socioeconomic Variables

Descriptive Statistics									
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Age	100	30	80	51.51	9.666	0.318	0.241	-0.108	0.478
Years of farmin	100	1	50	22.96	12.225	0.16	0.241	-0.809	0.478

g experience									
Monthly income from agriculture (approx.)	99	5000	70000	32707.07	15278.54	0.091	0.243	-0.136	0.481
House hold size	100	1	6	4.04	1.044	-0.136	0.241	0.175	0.478
Valid N (listwise)	99								

Gender Distribution of the sample

The gender distribution of the surveyed farmers is presented in Table 3 and as a simple pie chart in Figure 6 to visualize this distribution. The results show a significant gender disparity within the sample. Of the 100 respondents, 84 (84%) were male, while 16 (16%) were female.

Table 3 Badulla District Gender Distribution in the selected sample

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	84	84.0	84.0	84.0
	Female	16	16.0	16.0	100.0
	Total	100	100.0	100.0	

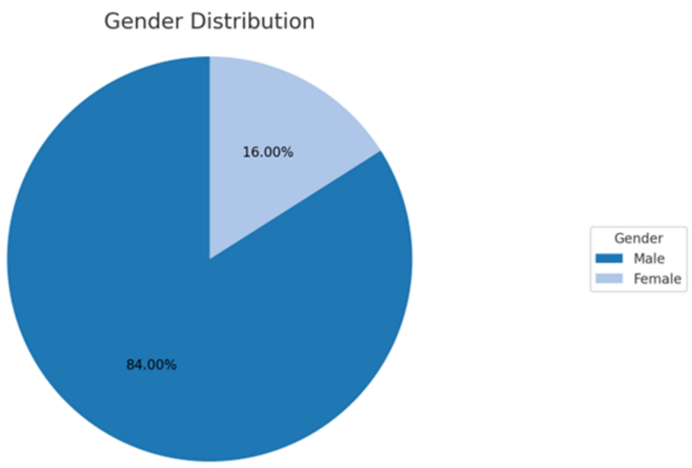


Figure 6 .Gender Distribution of the sample

Highest Education level

The educational achievement levels of the surveyed farmers are presented in Table 4. The majority of respondents (58%) had completed secondary education as their highest level of schooling. A further 26% had achieved Advanced Level qualifications, while 14% had only primary education. Tertiary education was rare among the sample, with only 2% of farmers holding a degree or higher qualification. In total, 98% of respondents had attained an Advanced Level education or less.

Table 4 .Educational Accomplishment of Respondents

Highest Education level					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary	14	14.0	14.0	14.0
	Secondary	58	58.0	58.0	72.0
	Advanced Level	26	26.0	26.0	98.0
	Tertiary	2	2.0	2.0	100.0
	Total	100	100.0	100.0	

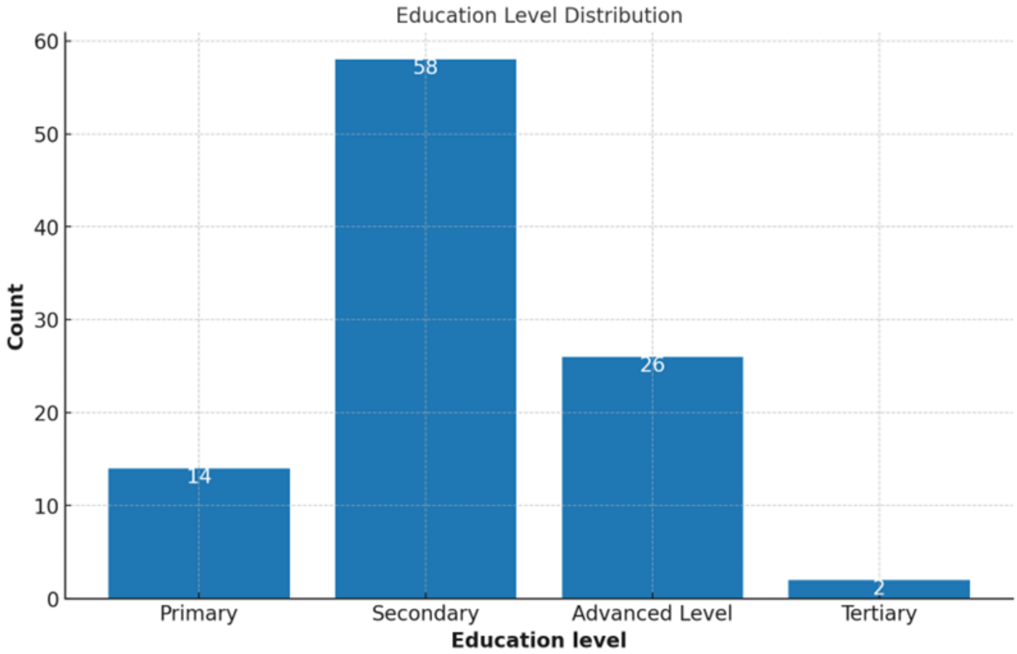


Figure 7 .Educational Accomplishment of Respondents

Land tenure

Land tenure arrangements among the surveyed farmers are presented in Table 5 and Figure 8. Respondents were asked to categorize their land access based on the following criteria: 'Owned' (holding formal legal title), 'Shared' (cultivating under informal, customary arrangements, often with family), and 'Leased' (paying rent or a share of the harvest to a landowner).

Land tenure arrangements among the surveyed farmers are presented in Table 5. The vast majority of respondents (86%) owned the land they cultivated. A smaller proportion (11%) operated under shared land arrangements, while only 3% reported leasing land. All respondents fell into one of these three tenure categories. These findings indicate that among the participants, land ownership is the norm and that shared and leased arrangements have little influence on access to land.

Table 5 Land Tenure Arrangements

Land tenure					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Owned	86	86.0	86.0	86.0
	Leased	3	3.0	3.0	89.0
	Shared	11	11.0	11.0	100.0
	Total	100	100.0	100.0	

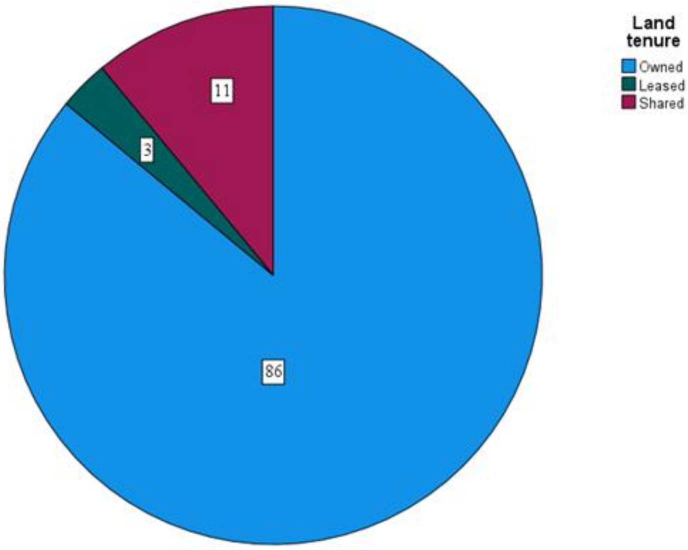


Figure 8 .Farmer Land Tenure Arrangements

Primary source of Income

The primary sources of income for the surveyed farmers are presented in Table 6. For this study, income sources were categorized as follows:

- Farming: Income generated solely from agricultural activities
- Non-Farming: Income generated solely from sources outside agriculture, such as government employment, private sector jobs, self-employment (e.g., shopkeeping, driving), remittances, or pensions.
- Both: A combination of income from both farming and non-farming sources.

The results indicate that farming is the dominant livelihood activity, with 63% of respondents relying solely on agricultural activities for their income. A mixed income strategy, which combines agricultural and non-farming occupations, was reported by another 26%. Only 11% of individuals derived their living entirely from non-farming sources. The fact that 89% of respondents reported farming as their primary or secondary source of income highlights the critical importance of agriculture to the sampled population.

Table 6 Badulla District farmers' primary source of Income

Primary source of income					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Farming	63	63.0	63.0	63.0
	Non Farming	11	11.0	11.0	74.0
	Both	26	26.0	26.0	100.0
	Total	100	100.0	100.0	

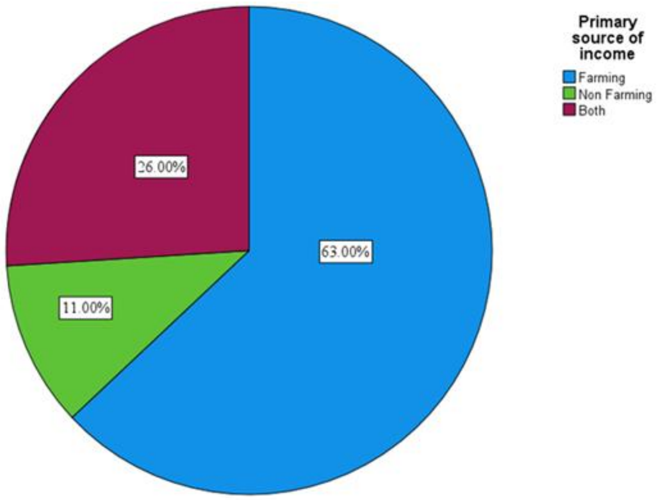


Figure 9. Primary Source of Income

4.1.2 Awareness and Perception of Climate Change

Farmers' awareness of climate change was assessed by asking whether they had heard of the term. The results are presented in Table 7 and Figure 10.
An overwhelming majority of respondents (95%) reported that they had heard of the term "climate change." Only a small minority (5%) stated they had not heard the term. The community's general awareness of climate change, as indicated by this finding, may encourage further dialogue, education, or legislative actions associated with climate adaptation and mitigation. The small percentage of ignorance (5%) might be an indication of specific knowledge access shortages, perhaps among underserved or underprivileged groups. All things considered, the data highlights a solid foundational awareness of climate change as an important concern.

Table 7 Farmer Awareness of the Term "Climate Change"

Have you heard of the term "climate change"?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	95	95.0	95.0	95.0
	No	5	5.0	5.0	100.0
	Total	100	100.0	100.0	

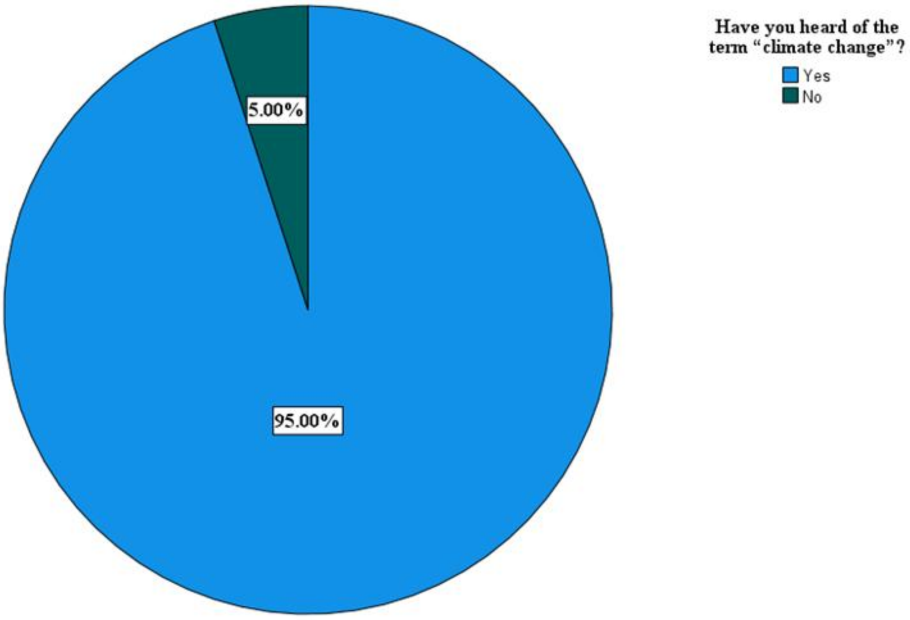


Figure 10 .Farmer Awareness of the Term "Climate Change"

Source from climate change Information

Farmers' primary sources of information about climate change are presented in Table 8 and Figure 11, Television and Radio were the most frequently cited sources, reported by 66% of respondents. This was followed by Agricultural Officers (9%), Schools (8%), and Newspapers (7%). The Internet was used by 5% of farmers, while consulting Other Farmers was the least common source (3%). Two responses were missing from this dataset.

Table 8 Distribution of Information Channels Used by Farmers

Source of Information					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	TV/Radio	66	66.0	67.3	67.3
	Internet	5	5.0	5.1	72.4
	Newspapers	7	7.0	7.1	79.6
	Agricultural Officers	9	9.0	9.2	88.8
	Other farmers	3	3.0	3.1	91.8
	School	8	8.0	8.2	100.0
	Total	98	98.0	100.0	
Missing	System	2	2.0		
Total		100	100.0		

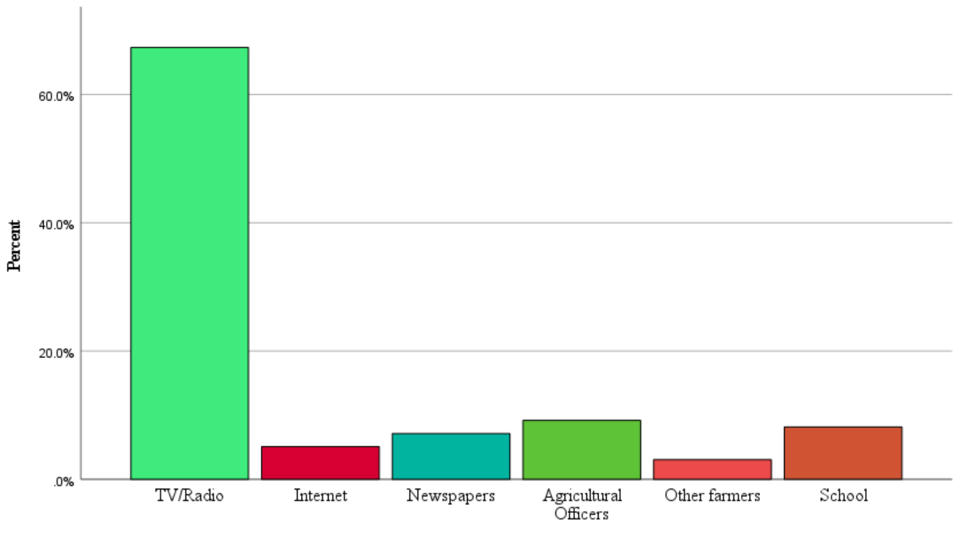


Figure 11.Distribution of Information Channels Used by Farmers

4.1.3 Associations between awareness of climate change and demographic variables

A cross-tabulation was conducted to examine the relationship between farmers' education level and their awareness of the term "climate change" (Table 9). While overall awareness was high (95%), the distribution across education levels showed notable variations.

All respondents with secondary (100%) and tertiary (100%) education reported awareness of climate change. Awareness was also high among farmers with advanced-level education (92.3%). The lowest awareness rate was observed among farmers with only a primary education (78.6%). All respondents who reported no awareness of climate change (n=5) belonged to either the primary (n=3) or advanced-level (n=2) education categories.

A Chi-Square Test (Table 10)of Independence was conducted to examine the association between education level (Primary, Secondary, Advanced Level, Tertiary) and awareness of the term "climate change" (Yes, No) among 100 farmers in the Badulla District, Sri Lanka. The results indicate a statistically significant association, $\chi^2(3, N = 100) = 11.510$, $p = 0.009$,(p-value is less than 0.05, the result is statistically significant, indicating that there is a meaningful association between the two categorical variables tested) with a moderate effect size (Cramer’s V = 0.339)(Table 11).

Specifically, farmers with Primary education were less likely to have heard of climate change (78.6% awareness) compared to those with Secondary (100%), Advanced Level (92.3%), or Tertiary (100%) education. Effect size was assessed using Cramer’s V, which produced a value of 0.339 ($p = 0.009$), indicating a moderate association between the variables. While these findings suggest a meaningful relationship, it should be noted that five cells (62.5%) had expected counts less than five, with the minimum expected count being 0.10. This violation of Chi-square assumptions warrants caution in interpretation, and future studies with larger sample sizes or adjusted category groupings are recommended to strengthen the reliability of these results

Table 9 Distribution of Climate Change Awareness Across Different Educational Backgrounds

Have you heard of the term "climate change"? * Education Level Crosstabulation							
			Education level				Total
			Primary	Secondary	Advanced Level	Tertiary	
Have you heard of the term "climate change"?	Yes	Count	11	58	24	2	95
		Expected Count	13.3	55.1	24.7	1.9	95.0
		% within Have you heard of the term "climate change"?	11.6%	61.1%	25.3%	2.1%	100.0%
		% within Education level	78.6%	100.0%	92.3%	100.0%	95.0%
	No	Count	3	0	2	0	5
		Expected Count	.7	2.9	1.3	.1	5.0
		% within Have you heard of the term "climate change"?	60.0%	0.0%	40.0%	0.0%	100.0%
		% within Education level	21.4%	0.0%	7.7%	0.0%	5.0%
Total		Count	14	58	26	2	100
		Expected Count	14.0	58.0	26.0	2.0	100.0
		% within Have you heard of the term "climate change"?	14.0%	58.0%	26.0%	2.0%	100.0%
		% within Education level	100.0%	100.0%	100.0%	100.0%	100.0%

Table 10 Chi-Square Tests

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.510[a]	3	.009
Likelihood Ratio	11.053	3	.011
Linear-by-Linear Association	1.486	1	.223
N of Valid Cases	100		
a. 5 cells (62.5%) have expected count less than 5. The minimum expected count is .10.			

Table 11 Symmetric Measures

Symmetric Measures			
		Value	Approximate Significance
Nominal by Nominal	Phi	.339	.009
	Cramer's V	.339	.009
N of Valid Cases		100	

4.1.4 Farmers perception of the main causes of climate change

Farmers' perceptions regarding the primary causes of climate change are presented in Table 12. A large majority of respondents (67%) believed that climate change is caused by a combination of both human activities and natural processes. A smaller proportion attributed climate change solely to human activities (18%) or solely to natural causes (6%). Nine percent of respondents reported being unsure of the causes

According to these findings, the majority of individuals acknowledge that both natural and man-made forces contribute to climate change, with a particular focus on human contribution. A tiny portion, nevertheless, is still unsure, suggesting possible knowledge gaps that might call for more education and awareness campaigns.

Table 12 Distribution of Farmer Views on Climate Change Causes

		Frequency	Percent	valid Percent	Cumulative Percent
Valid	Natural causes	6	6.0	6.0	6.0
	Human activities	18	18.0	18.0	24.0
	Both	67	67.0	67.0	91.0
	Not sure	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

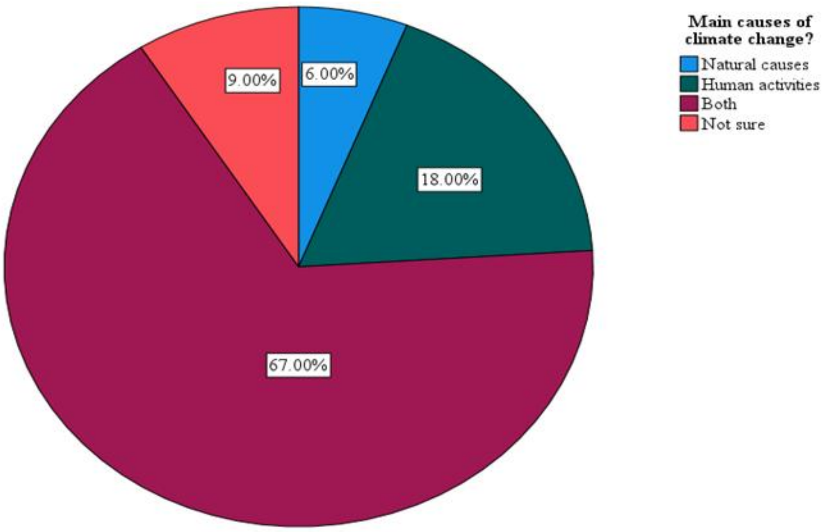


Figure 12. Distribution of Respondents' Views on Climate Change Causes

4.1.5 Local Perceptions of Climate-Related Changes in Agriculture

Irregular rainfall was the most frequently reported change, cited by 72% of respondents. This was followed by reduced rainfall (17%) and temperature increase (5%). Other changes were reported less frequently (Table 13).

Table 13 Frequency Distribution of Observed Climate Changes Over the Past 10 Years

Perceived Climate-Related Changes in the Past Decade					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Temperature increase	5	5.0	5.0	5.0
	Reduced rainfall	17	17.0	17.0	22.0
	Irregular rainfall	72	72.0	72.0	94.0
	Increased droughts	1	1.0	1.0	95.0
	Frequent floods	3	3.0	3.0	98.0
	New pests/diseases	1	1.0	1.0	99.0
	Other (specify)	1	1.0	1.0	100.0
	Total	100	100.0	100.0	

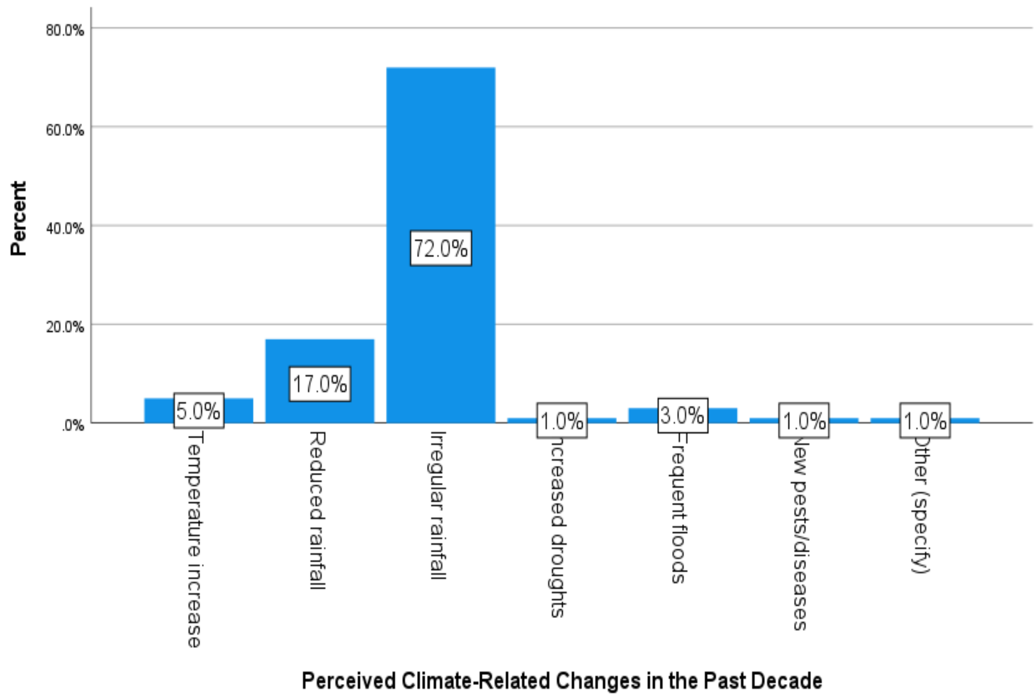


Figure 13 Frequency Distribution of Observed Climate Changes Over the Past 10 Years

Climate Adaptation Strategies and Practices

Farmers reported using a range of strategies to adapt to climate change. The most common practices were crop diversification (37%) and shifting planting or harvesting times (35.2%). Other practices, such as use of drought-resistant varieties (3.7%), mulching or composting (7.4%), and rainwater harvesting (7.4%), were reported less frequently. The least common practices were the use of organic fertilizers (5.6%), soil bunds or erosion control (1.9%), and other unspecified methods (1.9%) (Table 14).

According to the question, the" overall effectiveness of the adaptation strategies they used", most farmers mention only somewhat effective (51.0%). A smaller proportion considered their practices to be very effective (17.7%), while a few found them not effective (3.1%). A significant percentage of farmers (28.1%) were unsure about the effectiveness of their adaptation strategies (Table 15)

Table 14 Distribution of Climate Adaptation Practices Among Farmers

Climate Adaptation Practices					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Crop diversification	20	20.0	37.0	37.0
	Use of drought-resistant varieties	2	2.0	3.7	40.7
	Shifting planting/harvesting time	19	19.0	35.2	75.9
	Mulching or composting	4	4.0	7.4	83.3
	Rainwater harvesting	4	4.0	7.4	90.7
	Use of organic fertilizers	3	3.0	5.6	96.3
	Soil bunds or erosion control	1	1.0	1.9	98.1
	Other (specify)	1	1.0	1.9	100.0

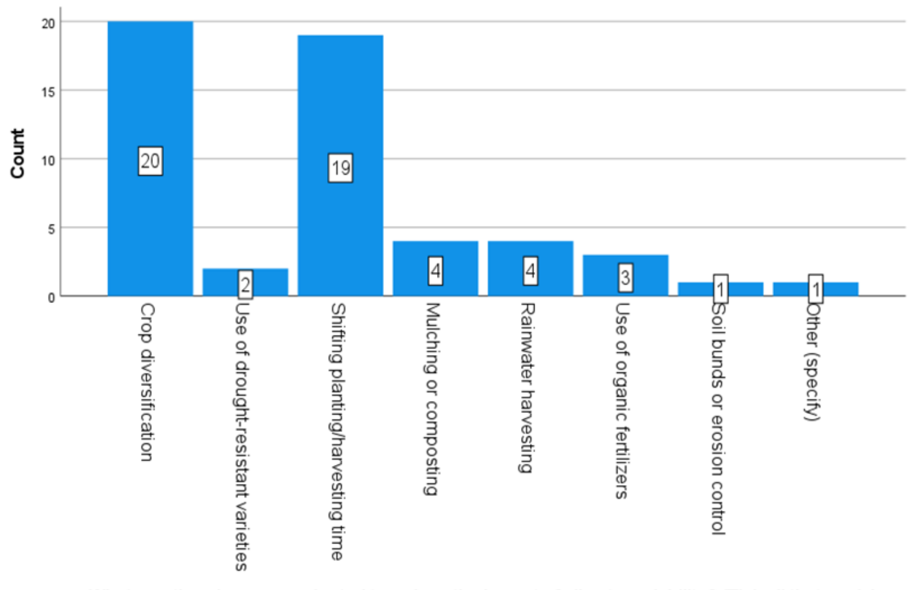


Figure 14 Distribution of Climate Adaptation Practices Among Farmers

Table 15. Effectiveness of Climate adaptation practices

Effectiveness of Climate Adaptation Practices					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very effective	17	17.0	17.7	17.7
	Somewhat effective	49	49.0	51.0	68.8
	Not effective	3	3.0	3.1	71.9
	Not sure	27	27.0	28.1	100.0
	Total	96	96.0	100.0	
Missing	System	4	4.0		
Total		100	100.0		

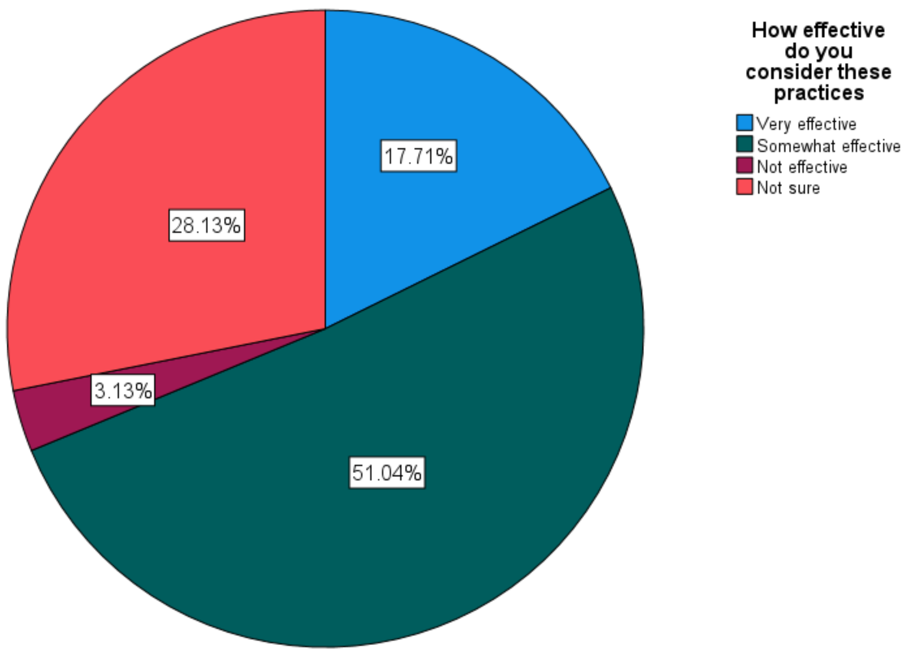


Figure 15 Effectiveness of Climate adaptation practices

Figure 16. Crop Cultivation and Protected Farming Methods in Badulla District, Sri Lanka,Mahiyanganaya, 2025/05/10,Photograph by Muthushka

Challenges in implementing adaptation strategies

The perceived barriers to adopting climate adaptation strategies, as reported by farmers, are presented in Table 16. The primary barriers to adopting climate-smart practices are lack of knowledge (46.5%), lack of money (41.4%), and limited access to inputs (9.1%), as reported in the survey. Qualitative findings emphasize additional challenges, including resistance to change among traditional farmers, particularly older generations, and structural issues like delayed irrigation water supply. Officers noted that farmers often do not understand the scientific term "climate change," complicating communication efforts, which supports the survey’s finding that awareness is lower among less-educated farmers.

Table 16 Challenges in implementing adaptation strategies

Challenges in implementing adaptation strategies					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lack of knowledge	46	46.0	46.5	46.5
	Lack of money	41	41.0	41.4	87.9
	Limited access to inputs	9	9.0	9.1	97.0
	Labour shortages	3	3.0	3.0	100.0
	Total	99	99.0	100.0	
Missing	System	1	1.0		
Total		100	100.0		

Figure 17. Field Observations of Farming Practices,2025/05/14,Bandarawela,Photograph by Nishan

4.1.6 Institutional Support and Information Access

Main sources of farming advice or support

The primary sources of agricultural advice and support for farmers are presented in Table 17. According to the survey's findings, farmers mostly depend on the Agriculture Department (65%), Extension Officers, and farmer associations (17% each), with NGOs having a very small influence (1%). This illustrates how government agricultural services have a significant impact on the spread of information, with farmer associations acting as a crucial secondary source for peer-based education. The low level of NGOs' involvement points to either a lack of presence or engagement in the area. These results demonstrate the centralized character of agricultural advisory systems in the research region, where institutional government assistance continues to be the main source of farming expertise. They also point to possible ways to improve alternative support channels, like farmer cooperatives or NGO collaborations, in order to establish a more varied agricultural advisory network.

Table 17 Main sources of farming advice or support

Main sources of farming advice or support					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agriculture Department	65	65.0	65.0	65.0
	Extension Officers	17	17.0	17.0	82.0
	NGOs	1	1.0	1.0	83.0
	Farmer groups	17	17.0	17.0	100.0
	Total	100	100.0	100.0	

Frequency of Receiving Agricultural Information

Farmers reported varying frequencies of receiving agricultural information, as detailed in Table 18. While 29.5% received information weekly and 11.6% monthly, a significant portion received information only occasionally (21.1%) or rarely (13.7%). Notably, 24.2% of farmers reported that they never receive agricultural information. Five responses were missing from this dataset.

Table 18 Frequency of Receiving Agricultural Information

Frequency of Receiving Agricultural Information					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Weekly	28	28.0	29.5	29.5
	Monthly	11	11.0	11.6	41.1
	Occasionally	20	20.0	21.1	62.1
	Rarely	13	13.0	13.7	75.8
	Never	23	23.0	24.2	100.0
	Total	95	95.0	100.0	
Missing	System	5	5.0		
Total		100	100.0		

4.2 Qualitative Data Analysis

4.2.1 Thematic Analysis

Thematic analysis, following the six-phase framework by Braun and Clarke (2006), was employed to analyse qualitative data from in-depth interviews with four key informants from the Provincial Department of Agriculture. The participants held senior roles in extension, training, and research and development (see Table 1 for full profiles).Interviews were conducted in Sinhala via WhatsApp, recorded with permission, and subsequently transcribed and translated into English. The transcripts were systematically coded to identify recurring themes and patterns related to institutional experiences and challenges in supporting climate adaptation in the Badulla District.Through this process, I have identified four primary themes: (1) Practical awareness amidst limited scientific understanding, (2) Adaptive practices under resource constraints, (3) Institutional gaps in supporting adaptation, and (4) Resistance to change and socioeconomic barriers. These themes, supported by illustrative quotes in the following sections, provide crucial institutional perspectives. They complement the quantitative survey data from farmers and align with the study's objectives, conceptual framework by following institutional theory.

Coded Transcript from Key Informant Interviews

The thematic analysis of key informant interviews revealed four central themes concerning institutional perspectives on climate adaptation challenges in the Badulla District. These themes, derived from the process outlined in Section 3.5.2, are shown in Tables 19 and 20.

Table 19 Interview coding

Transcript	Codes
KI- 1 : "*Most farmers don't understand the scientific meaning of 'climate change,' but they know something is changing. In the past, they knew what to plant and when. Now they say, 'We can't choose crops like before.* " **KI-2** : "*We don't call it 'climate adaptation', we say, 'This will improve your yield.*'"	Practical awareness of climate impacts Limited scientific understanding, Disruption of traditional farming practices
KI- 4 *"They change the type of crop depending on the climate... in drought, they avoid paddy and choose crops needing less water"* **KI-1** "*Farmers who grow potatoes now use sprinklers or drip irrigation because rainfall is unreliable".* "	Crop management adaptation Climate-driven crop selection
KI-1 "*One year, the average rainfall was 600 mm; the next year, it was 1200 mm. So it's hard to predict."*	Weather Variability
KI- 1 " *Unpredictable rain has disrupted flowering and harvesting patterns for crops like oranges and pears."*	Agricultural Disruptions
KI- 1 "*Farmers now use sprinkler and drip irrigation instead of traditional canal systems."*	Water Management Technologies

Interviewer: *Right, so they adjust based on the weather?* **KI-** 4 "*Yes, but some leave the land fallow in bad seasons based on forecasts.* " **KI-3** "*Traditional farmers resist new methods; only progressive farmers adopt them.*" **KI -3** " *Local farmers are slow to adopt [new technology]. They prefer using traditional methods*."	Seasonal farming adjustments Reliance on weather forecasts Resistance to technological change Preference for traditional practices Slow adoption of innovations
Interviewer: Why do you think that is? **KI- 3** " Even with 50% subsidies, many farmers cannot afford the remaining costs. "	Financial constraints Limited access to technology Role of farmer organizations
KI-2 "*We organize awareness programs through farmer organizations... mostly done through outdoor training sessions*".	Institutional support through training
KI-3 : "*We provide a Crop Calendar annually, showing which crops to plant in which seasons, with rainfall predictions from meteorological stations.*	Institutional planning tool
KI-4: "*We warn farmers to delay sowing when heavy rain is forecasted, but many ignore the Calendar and face losses.*"	Limitations in the Utilization of Institutional Support

Interviewer: Are these programs effective? **KI- 2** "*Many are aware now... even through social media, but we don't have specific programs that directly address climate change."*	Increased awareness via social media Lack of climate-specific programs, Institutional gaps Technological adoption
KI- 1: " *In Bandarawela and Welimada, they use sprinkler systems and drip irrigation... Polytunnels and greenhouses are promoted in hilly areas. "*	Micro-irrigation systems, Protected agriculture
KI-1 "*We have some drafted policies, but are they implemented?* *"Policies exist, but their grassroots implementation is questionable."*	Ineffective policy implementation
KI-3 *"Youth are not interested in farming, except in protected agriculture*." **KI- 1** : "*Young farmers call us to ask about new technologies, but the older generation sticks to what they know.*"	Lack of climate-specific policies Low youth engagement Interest in modern farming techniques Youth Engagement and Technology

Table 20 Generating them

Theme	Definition	Associated Codes
Practical awareness amidst limited scientific understanding	Farmers recognize climate change impacts through experiential knowledge but lack scientific understanding, limiting proactive adaptation.	Practical awareness of climate impacts, Limited scientific understanding, Disruption of traditional farming practices, and increased awareness via social media**,** Crop Calendars as Climate Adaptation Guides**,** Role of farmer organizations
Adaptive practices under resource constraints	Farmers employ practical strategies like crop management and technology adoption to cope with climate variability, constrained by financial and knowledge barriers.	Crop management adaptation, Climate-driven crop selection, Seasonal farming adjustments, Reliance on weather forecasts, Technological adoption, Micro-irrigation systems, Protected agriculture
Institutional gaps in supporting adaptation	General agricultural programs (Yala/Maha)lack a climate-specific focus, leaving farmers reliant on limited institutional support and coordination.	Crop Calendars as Climate Adaptation Guides, Institutional support through training, Role of farmer organizations, Lack of climate-specific programs, Institutional gaps, Ineffective policy implementation
Resistance to change and socioeconomic barriers	Cultural preference for traditional methods, financial constraints, and low youth engagement hinder the adoption of adaptive practices.	Resistance to technological change, Preference for traditional practices, Slow adoption of innovations, Financial constraints, Limited access to technology, Low youth engagement, Interest in modern farming techniques, Limitations in the Utilization of institutional support

Definitions and Labels for Selected Themes

1. Practical awareness amidst limited scientific understanding.

This theme captures the experiential, practice-based awareness (e.g., shifting rainfall patterns, crop failures) among Badulla District farmers of climate change impacts, such as erratic rainfall and prolonged droughts, in contrast to their limited understanding of the scientific concept of climate change(e.g., greenhouse gases, global warming). Most of the farmer adaptation strategies are grounded in observed environmental changes rather than technical knowledge (e.g., shifting rainfall patterns, crop failures).

This awareness, while informed by experience and media, limits farmers' ability to connect observations to proactive adaptation strategies. Farmers in Badulla District demonstrate acute observational awareness of environmental changes such as erratic rainfall and prolonged droughts, but often attribute these shifts to natural cycles or divine will rather than anthropogenic climate change.

However, this awareness, while informed by experience and media, often limits their ability to connect observations to proactive, scientifically informed adaptation strategies.

2. Adaptive practices under resource constraints.

This theme encapsulates farmers' practical strategies to mitigate climate variability, including crop management, seasonal adjustments, and selective technology adoption, while navigating financial and knowledge constraints.

3. Institutional gaps in supporting adaptation.

This theme highlights the lack of targeted institutional support for climate adaptation, as general agricultural programs often fail to address specific climate challenges.
A key example of this gap is the underutilization of the Crop Calendar. The interviews revealed that the Department of Agriculture issues an annual Crop Calendar to help farmers align planting with seasonal forecasts. However, awareness of this tool among farmers is very low, and it is often ignored in favor of traditional planning, highlighting a significant failure in dissemination and support. This gap hinders farmers' adaptive capacity.

4. Resistance to change and socioeconomic barriers.

This theme addresses cultural, financial, and demographic barriers to adaptation, including resistance to change and low youth engagement.

4.2.2 Synthesizing Knowledge and Outlining Strategies for Climate Resilience

Theme 1: Practical awareness amidst limited scientific understanding

Farmers in Badulla District establish a high degree of empirical, observational awareness of climate change impacts but operate with a critically limited understanding of its scientific basis. This epistemic gap between practical observation and scientific framing constrains their adaptation strategies, keeping them reactive and localized rather than proactive and systematic.This is directly evidenced by the consistent testimony of key institutional informants:Most farmers recognize climate Change without Scientific Framing.KI-1 stated,

"Most farmers don't understand the scientific meaning of 'climate change,' but they know something is changing... Now they say, 'We can't choose crops like before."(KI-1)

This highlights the disruption of traditional knowledge systems without their replacement with a scientific framework.Farmers are reactive, not proactive. Adaptation: This can show KI-4 confirmed that farmer responses are situational:

"They change the type of crop depending on the climate... in drought, they avoid paddy and choose crops needing less water." (KI-4)

This indicates adaptation is a direct reaction to immediate stressors rather than part of a long-term plan based on climate forecasts.The most striking aspect of this theme is the degree to which farmers accept limited scientific understanding as a given. KI-3 statement,

"They prefer using traditional methods."(KI-3)

This indicates that farmers rely on familiar practices to navigate uncertainty, avoiding the trouble of adopting unfamiliar technologies.
Unproductive Knowledge Transfer is another reason for the awareness gap. The underutilization of the scientifically-based Crop Calendar (figure 18)(Appendix 1)underscores this gap. KI-3 noted,

"We provide the Crop Calendar, but many farmers don't use websites or apps to observe." (KI-3)

This points to a failure in institutional communication channels. Further KI - 4 added,

"We warn farmers to not to do the sawing one time... but many ignore and lose their yield"(KI-4)

This proves that farmers default to their own experiential knowledge even when scientific guidance is available.

This finding is significant because it identifies the nature of farmer awareness as a key determinant of adaptive capacity. Farmers are aware of the symptoms (e.g., erratic rain, crop failure) but not the diagnosis (anthropogenic climate change). Consequently, their responses are tactical (e.g., switching crops post-drought) rather than strategic (e.g., implementing soil conservation based on a forecast). This reliance on experiential knowledge, while resilient in the short term, increases long-term vulnerability to rising and new climate risks. The institutional failure to effectively translate and deliver scientific knowledge complicates this vulnerability.

This qualitative insight provides the 'why' behind the quantitative finding that while 95% of farmers had heard the term "climate change," only 18% attributed it solely to human activities. It explains that the term holds little scientific meaning for them, representing a critical communication gap between scientific institutions and the agricultural community.

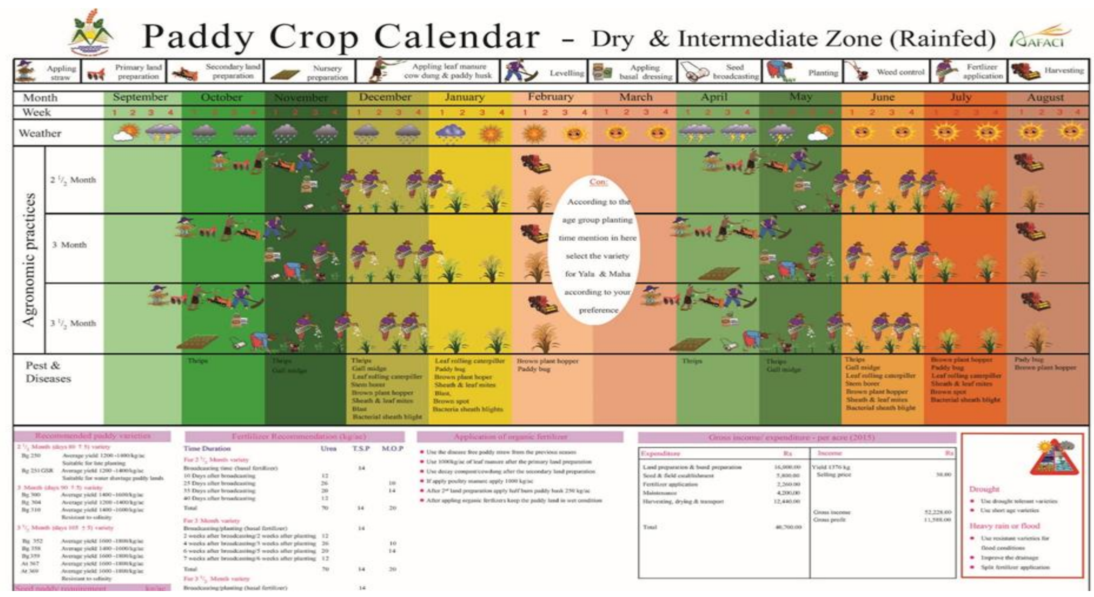


Figure 18 Crop calender from department of Agriculture,Sri lanka 2025

Theme 2 : Adaptive practices under resource constraints

Farmers in Badulla District demonstrate important activity and practicality by employing a range of adaptive strategies to cope with climate variability. The most prevalent adaptation is crop management, specifically shifting cultivation choices based on water availability, as captured in the statement

> "They change the type of crop... in drought, they avoid paddy and choose crops needing less water" (KI- 4)

For example, during prolonged dry periods, many farmers shift from water-intensive paddy cultivation to crops like maize, black gram, or vegetables that require less irrigation. Other common strategies include seasonal adjustments, such as leaving land fallow based on forecasts during predicted drought seasons, and the selective adoption of technologies like drip irrigation systems in water-scarce areas like Bandarawela and Welimada, or greenhouses in cooler upland regions for vegetable production.However, the scope and effectiveness of these adaptations are severely controlled by significant socioeconomic barriers. A primary constraint is financial limitation, as even with subsidies, the cost of technology remains prohibitive for many

> "Even with 50% subsidies, many farmers cannot afford the remaining costs" (KI-3)

For instance, a smallholder farmer might qualify for a subsidy on a drip irrigation kit but still lack the funds for the remaining 50% cost, installation expenses, or the increased electricity costs for running water pumps. This results in a pattern of constrained pragmatism, where farmers make tactical, short-term adjustments within their means (such as switching to drought-tolerant crops) but are systematically prevented from making larger, transformative investments (like installing efficient irrigation systems or protected agriculture structures) that would ensure long-term resilience. Their adaptation is therefore not a function of choice alone, but a direct reflection of their resource capacity and the structural barriers they face. This explains why many farmers continue to prefer traditional methods despite awareness of modern technologies - their adaptation strategies represent rational responses within their socioeconomic constraints rather than resistance to change itself.

Theme 3: Institutional gaps in supporting adaptation.

This study reveals critical institutional gaps in supporting climate adaptation, characterized by structural, communication, and implementation failures that undermine farmers' resilience. Key informants consistently reported a mismatch between existing programs and climate-specific needs. As one official stated

"Our training programs cover general agriculture, fertilizer use, pest management, but we lack dedicated modules on climate-resilient farming. Farmers learn about drought-tolerant crops by chance, not by design" (KI-3).

Another example of this gap is the poor dissemination and uptake of the Climate Smart Agricultural Calendar. Despite being a scientifically robust tool for aligning planting with seasonal forecasts, its distribution relies heavily on digital platforms inaccessible to many farmers.

"We provide the Crop Calendar, but many farmers don't use websites or apps. They rely on word-of-mouth from neighbors."(KI-3)

While the calendar is distributed via Agriculture Instructors (AI), its guidance is rarely reinforced with field demonstrations or localized training. This top-down approach lacks participatory localization, demonstrable field training, or follow-up, resulting in low adoption rates and reduced credibility of institutional advice. The avoidance of climate-focused language further exacerbates these gaps. Officials intentionally reframe climate adaptation as yield improvement to avoid overwhelming farmers,

"We never say 'climate adaptation', we say, 'This method will save your water and give better harvests'"(KI 2).

While practically motivated, this strategy risks oversimplifying complex climate challenges and discourages proactive planning. For instance, soil moisture conservation or crop diversification for climate resilience are rarely promoted as integrated strategies, leading to fragmented and temporary solutions.

Policy-implementation decoupling was widely reported. Although national policies like the Climate Smart Irrigated Agriculture Project (CSIAP) exist, their translation to grassroots action remains weak.

“Policies are drafted in Colombo, but field staff lack resources, training, and mandates to execute them. There is no budget for climate-specific training or tools” (KI-4).

Another added,

“We are still evaluated based on traditional metrics like crop yield targets, not on adaptation outcomes such as reduced vulnerability or enhanced soil health” (KI- 1)

This institutional inertia prioritizes short-term productivity over long-term resilience. One official mentioned

, “Many farmers do not use the mobile app yet”(KI-2)

this indicates limited digital engagement. These gaps force farmers to rely on their own resources. Farmers perceive institutional support as inadequate, accepting it as a normal limitation. Interviewee 4comment on delayed irrigation reflects frustration with coordination, yet farmers adapt within these constraints. This internalization highlights the need for targeted, climate-focused programs to bridge institutional gaps and enhance adaptive capacity.

These institutional gaps have tangible consequences: farmers receive contradictory advice, lack access to scalable adaptation technologies, and remain dependent on reactive and often unsustainable coping mechanisms. Without institutional reforms that prioritize climate literacy, localized support, and resource allocation for adaptive planning, farmers’ capacity to respond to escalating climate risks will remain severely constrained.

Theme 4: Resistance to change and socioeconomic barriers.

This theme identifies a critical generational schism that compounds barriers to climate adaptation. A significant resistance to new agricultural methods persists, particularly among older farmers who exhibit a strong cultural preference for traditional practices. As one official noted,

“Local farmers are slow to adopt new technology. They prefer using traditional methods. “Even with 50% subsidies, many farmers cannot afford the remaining costs” (KI-3),

This is often due to a combination of financial constraints. and deep-seated risk aversion developed over a lifetime of farming.

However, this resistance is not uniform across all demographics. A clear generational divide is emerging: while older farmers remain anchored to conventional practices, a segment of younger individuals shows a marked interest in modern, technology-driven agriculture. This deviation is captured in two conflicting insights.

> "Youth are not interested in farming, except in protected agriculture" (KI-3) and "Young farmers call us to ask about new technologies, but the older generation sticks to what they know" (KI-1).

This indicates that youth engagement is highly conditional; they are not rejecting farming outright but are primarily attracted to higher-tech, potentially more profitable, and less climate-vulnerable forms of agriculture like greenhouse cultivation or precision farming. This creates a paradoxical situation where the future of farming depends on engaging a youth population that is disappointed with traditional methods, while current agricultural resilience is held back by an aging population reluctant to change. Overcoming this dualistic barrier requires targeted interventions that both subsidize proven technologies for older farmers and aggressively promote and support capital-intensive, tech-enabled agriculture for the younger generation.. Farmers internalize these barriers as normal, avoiding risky innovations to maintain stability. Resistance and socioeconomic constraints limit transformative adaptation, underscoring the need for targeted interventions.

Farmers in Badulla District exhibit a high degree of practical, observational awareness of climate change impacts, such as erratic rainfall and drought, yet their adaptation strategies are constrained by a limited understanding of its scientific basis. This epistemic gap reflects a mediation process shaped by the interplay of socioeconomic conditions, institutional support systems, and perceived environments, as outlined in institutional theory (Agrawal 2008; Gnanasubramaniam & Hemachandra 2020; Scott 1995).

This finding is illuminated through the three pillars of institutional theory. The regulative pillar highlights the underutilization of formal tools like the scientifically-based Crop Calendar, with key informants (KI-3) noting, "We provide the Crop Calendar, but many farmers don't use websites or apps to observe," pointing to ineffective institutional communication and rule enforcement. The normative pillar is evident in farmers' reliance on social norms and traditional knowledge, as KI-3 stated, "They prefer using traditional methods," reflecting conventional behaviors and community expectations that shape their responses. The cultural-cognitive pillar underscores deeply embedded attitudes, with KI-1 observing, "Most farmers don't understand the scientific meaning of 'climate change,' but they know something is changing," indicating how ingrained perceptions limit proactive adaptation.

This alignment with institutional theory is particularly relevant in the Sri Lankan context, where agricultural practices are rooted in social networks and traditional systems. The study reveals that institutional failures in translating scientific knowledge—evidenced by KI-4's comment, "We warn farmers... but many ignore and lose their yield"—hinder effective adaptation. This supports international evidence that successful adaptation depends not only on individual awareness but also on the institutional contexts that facilitate knowledge transfer and support (Cuevas 2018). Consequently, the reliance on experiential knowledge, while resilient in the short term, increases long-term vulnerability, underscoring the need for institutional reforms to bridge this gap. Part 4.3 will explain in detail this theoretical analysis.

4.3 Theoretical Analysis

This study demonstrates that the vulnerability of farmers in Badulla District to climate change is not solely due to environmental factors but is significantly influenced by systemic institutional weaknesses. Applying Scott (2014) institutional theory framework. This study reveals how:

1. Regulative failures are empirically demonstrated by the underutilization of the Crop Calendar and the finding that 24.2% of farmers never receive agricultural information (Table 18), highlighting a critical gap between policy design and practical implementation.

2. Normative resistance is evidenced by the institutional practice of avoiding the term "climate adaptation," reframing it as "yield improvement" (KI-2), which ultimately limits farmers' systemic understanding of climate risks.

3. Cultural-cognitive gaps are quantified by the perception data, which shows that while 95% of farmers have heard of climate change, only 18% attribute it primarily to human activities (Table 12), reinforcing a reliance on experiential knowledge over scientific forecasts.

These institutional weaknesses intersect with and exacerbate the socioeconomic constraints clearly documented in our survey: the high cost of technology (cited as a major barrier by KI-3), which results in the low adoption of drought-resistant seeds (3.7%, Table 14), and the generational divide in technology adoption. This synergy creates what (Khan et al. 2023) term an "adaptation poverty trap," where the inability to invest in long-term resilience measures keeps farmers in a cycle of vulnerability, a finding directly supported by the low farmer confidence in the effectiveness of their current strategies (51% find them only somewhat effective, 28.1% are unsure, Table 15)."

Further, this analysis reveals how institutional decoupling (the gap between policy intent and implementation) intensifies adaptation challenges. Regulative failures are evident in the poor execution of national policies. For instance, the Climate Smart Irrigated Agriculture Project (CSIAP) has been ceremonially adopted but remains poorly implemented. This is reflected in the finding that 24.2% of farmers never receive agricultural information (Table 18), and the Crop Calendar, a scientifically designed planning tool, is severely underutilized.
This decoupling is further manifested in a normative-cultural disconnect. Agricultural officers avoid using terms like "climate adaptation," reframing them as "yield improvement" (KI-2). While this approach may simplify communication, it obscures the systemic nature of climate change and limits farmer understanding. Quantitative data support this: only 18% of farmers attribute climate change primarily to human activities (Table 12), indicating a significant gap in climate literacy.
Consequently, farmers' adaptation practices remain largely reactive and experience-based. Crop diversification (37%) and shifting planting dates (35.2%) are common (Table 14), while the adoption of drought-resistant varieties (3.7%) remains low. This preference for familiar, low-risk strategies over transformative measures is not due to resistance but constrained agency, where high costs, even with subsidies (KI-3), and limited institutional support restrict options.
Ultimately, the three institutional pillars interact dysfunctionally: regulative failure encourages normative shortcuts, which in turn reinforce farmers' reliance on traditional knowledge. This traps the agricultural system in a cycle of short-term coping rather than long-term resilience building. The study confirms that institutional alignment is essential for enhancing adaptive capacity. Without coherent policies, effective science communication, and financially accessible technologies, vulnerability becomes embedded at a systemic level.

4.3.1 The Regulative Gap: Policy Design and Practical Implementation

The failure of the regulative pillar is characterized by a significant gap between policy design and practical implementation, rendering national strategies like the Climate Smart Irrigated Agriculture Project (CSIAP) largely symbolic. This ceremonial adoption is evident in several critical failures. Firstly, the dissemination of crucial information is profoundly ineffective, leaving 24.2% of farmers completely excluded from institutional advisory channels (Table 18). Secondly, the scientifically-designed Crop Calendar, a key regulative tool, is severely underutilized due to poor distribution and a lack of training, as officials noted that farmers "don't use websites or apps" and instead rely on informal networks (KI-3). Thirdly, financial support mechanisms are decoupled from farmers' realities; despite a 50% subsidy for technologies, the remaining cost remains prohibitive for most, as highlighted by the statement, “Even with 50% subsidies, many farmers cannot afford the remaining costs” (KI-3). This collective failure creates an "implementation shadow," where frontline officers, lacking mandates, budgets, and performance metrics for climate programs, default to conventional, yield-centric routines. The result is a regulatory system that simulates compliance but fails to provide the structured, accessible support farmers need, thereby exacerbating their vulnerability.

4.3.2 The Normative-Cultural Mismatch: Miscommunicated Science and Experiential Legitimacy

A critical communication breakdown occurs between agricultural institutions and farmers, stemming from a well-intentioned but ultimately limiting strategy. Guided by a practical mindset, extension services deliberately simplify their language, avoiding scientific terms like "climate adaptation" in favor of phrases like "This will improve your yield." While this approach aims to make advice more relatable, it severely truncates farmers' understanding of climate change, preventing them from seeing it as a large-scale, human-caused crisis. This is quantitatively evident in the perception data: while 95% of farmers have heard of climate change, only 18% primarily blame human activities, with most (67%) viewing it as a hybrid natural-human phenomenon. This limited understanding reinforces a deep reliance on personal experience, where farmers trust observed patterns, like erratic rainfall, over institutional forecasts. Consequently, their adaptation strategies remain reactive and localized, such as switching crops after a drought begins, rather than being proactive and systematic. By failing to effectively translate science into resonant narratives, institutions inadvertently legitimize short-term coping over long-term resilience, trapping farmers in a cycle of vulnerability.

4.3.3 The Cultural-Cognitive Pillar: The Internalized Worldview Constraining Adaptation

Farmers' ability to adapt is deeply shaped by their beliefs and worldview, which form the cultural-cognitive pillar of institutions. This shared mindset, built on tradition and direct experience, makes certain actions feel natural and others seem risky or unnecessary. This is empirically demonstrated by the survey result that 67% of farmers perceive climate change as a mix of natural and human causes, while only 18% attribute it primarily to human activities (Table 12). Because of this view, they see reactive strategies like the 35.2% who shift planting times (Table 14) as the logical and sensible thing to do. In contrast, proactive measures promoted by science, like the mere 3.7% adopting drought-resistant varieties (Table 14), are viewed as unfamiliar and illegitimate. This mindset is reinforced by institutions that avoid discussing "climate change" directly, instead using simple terms like "improving yield" (KI-2). Consequently, farmers come to see their limitations, such as the high cost of technology, as unchangeable facts of life rather than problems to be solved. This acceptance of the status quo, where traditional methods are trusted and constraints are seen as permanent, creates the most profound barrier to change, trapping farmers in a cycle of vulnerability where only short-term coping feels possible.

Farmers in Badulla District face a paradox of constrained agency, meaning they are actively working to adapt to climate change but are severely limited by institutional failures. Their high adoption of low-cost strategies like crop diversification and shifting planting dates is a rational and pragmatic response to the financial and knowledge barriers they face, not a sign of resistance to change. The very low uptake of more effective but costly measures, like drought-resistant seeds or drip irrigation, is directly due to prohibitive costs, even with subsidies, and a lack of accessible support. This situation forces farmers into a pattern of short-term coping that maintains immediate harvests but fails to build long-term resilience, ultimately transferring the entire risk of climate change from institutions onto individual farmers and their families.

This integrated conceptual-theoretical framework, merging the vulnerability model with Scott's institutional pillars, has proven essential in systematically diagnosing the root causes of inadequate climate adaptation in Badulla District. It provided the structure to move beyond describing what farmers are doing to explaining why they are trapped in a cycle of short-term coping. The framework allowed us to dissect the broad concept of "institutional support" into its core components (regulative, normative, cultural-cognitive), revealing how failures within and between these pillars actively erode adaptive capacity. Consequently, this analysis directly answers this thesis's core research question: farmers' adaptation is limited not by a lack of awareness or effort, but by a deeply embedded institutional misalignment that makes transformative change impossible under the current system. The model successfully exposed how policies without implementation, advice without literacy, and knowledge without translation interact to privatize climate risk onto individual households. Therefore, this integrated framework does not merely describe vulnerability; it provides a precise diagnostic tool for targeting interventions, suggesting that future resilience depends not on changing farmers but on transforming the institutional structures that govern their choices

5. Discussion

5.1 RQ1: Farmer perception and awareness influence the adoption of climate change adaptation strategies

Understanding farmers' perceptions and awareness is a critical starting point for examining how they respond to climate variability and change. This study delivers compelling evidence that Badulla District farmer' perceptions and awareness of climate change significantly shape their adoption of adaptation strategies, though this relationship is facilitated by multiple socioeconomic and institutional factors. Perception shapes how risks are recognised, while awareness, both experiential and scientific, determines whether farmers adopt reactive coping strategies or proactive, climate-smart practices. In the Badulla District context, where agriculture is highly dependent on seasonal rainfall and exposed to erratic weather patterns, these factors directly influence the choice and effectiveness of adaptation measures.

My research survey findings reveal a paradox where 95% of farmers report familiarity with the term "climate change," yet only 18% correctly attribute it solely to human activities, with 67% believing it results from mixed natural and human causes. This disconnect between awareness and scientific understanding mirrors findings by Leiserowitz et al. (2013).In developing country contexts, experiential knowledge often outweighs technical comprehension of climate systems. Farmers demonstrate acute observational awareness of environmental changes, particularly erratic rainfall (noted by 72% of respondents) and reduced precipitation (17%), while showing less concern about temperature increases (5%) or extreme events like floods (3%). This pattern aligns with Mertz et al. (2011) Work in the Sudano-Saheli, where farmers prioritized immediate, visible climate impacts over gradual changes. This pattern suggests that rainfall variability is the most immediate and noticeable driver of awareness, uncontrollable, slower-onset changes such as temperature rise, a trend similarly observed in rural agricultural communities in Sri Lanka and beyond (Herath &Thirumarpan 2017).

The qualitative interviews provide deeper insight into this experiential awareness. As one agricultural officer explained,

> "Most farmers don't understand the scientific meaning of 'climate change,' but they know something is changing. “In the past, they knew what to plant and when.” Now they say, 'We can't choose crops like before.'"(KI-1)

This practical, observation-based understanding drives specific adaptation behaviors, particularly crop switching during droughts, as another interviewee noted:

"They change the type of crop depending on the climate... in drought, they avoid paddy and choose crops needing less water." (KI-2)

Such responses reflect what Esham and Garforth (2013) the Term "reactive adaptation" immediate adjustments to observed changes rather than long-term planning based on climate projections. Interview accounts strengthened these findings, highlighting the gap between experiential knowledge and scientific framing. Farmers frequently notice shifts in rainfall timing, prolonged droughts, and disrupted crop cycles, but seldom relate them to broader climate science concepts such as greenhouse gases or global warming. KI-2 noted that awareness has increased

"even through social media", while Interviewee 3 observed that
"They prefer using traditional methods."(KI-2)

This indicates hesitancy to adopt unfamiliar or technically demanding practices. These insights are consistent with findings by Udmale et al.(2014), which show that rural farmers' adaptation choices are primarily guided by lived experience and peer norms, with limited uptake of scientific tools.

One such tool is the Department of Agriculture's annual Crop Calendar (https://doa.gov.lk/naicc-publications-crop-calender/), which provides seasonal crop recommendations based on meteorological forecasts. Distribution occurs via Agricultural Instructors at the start of each year, yet farmer awareness and utilisation remain low. As KI-3 stated,

"We provide the Crop Calendar annually, but many farmers don't use websites or apps." Similarly, Interviewee 4 reported that "we receive warnings to delay sowing due to forecasted heavy rains are often ignored, resulting in yield losses"(KI-3)

This mirrors observations in other South Asian contexts where digital literacy and institutional follow-up are critical barriers to the effective use of advisory services(Akhtar et al. 2018; Udmale et al. 2014). The statistical analysis confirmed a significant association between education level and climate change awareness ($\chi^2(3, N = 100) = 11.510$, $p = 0.009$, Cramer's $V = 0.339$), with farmers holding primary education showing notably lower awareness (78.6%) than those with secondary (100%), advanced level (92.3%), or tertiary (100%) education.

This relationship aligns with past Sri Lankan studies indicating that higher educational attainment enhances farmers' ability to interpret and act upon climate-related information (Herath & Thirumarpan 2017; Marambe et al.2015). However, it is important to note that five cells (62.5%) in the Chi-square test had expected counts below five, warranting cautious interpretation and the recommendation for future studies to use larger or more balanced samples. And these finding supports the institutional theory (scott, 2014), which suggests that education enhances perceived behavioral control and adaptation capacity. However, even educated farmers often rely on traditional knowledge systems, as evidenced by the underutilization of scientific tools like the Department of Agriculture's Crop Calendar.

The adaptation strategies adopted reflect these complex awareness patterns. Crop diversification (37%) and shifting planting/harvesting times (35.2%) dominate as low-cost, experience-based responses, while more technologically advanced practices like using drought-resistant varieties (3.7%) remain rare. This aligns with (Herath and Thirumarpan, 2017). Study of Sri Lankan dry zone farmers reveals an important tension - only 17.7% of farmers consider their current strategies "very effective," suggesting recognition of their limitations against intensifying climate impacts. The barriers to more effective adaptation are multifaceted: 46.5% cite lack of knowledge, 41.4% identify financial constraints, and institutional weaknesses persist, as one official admitted: they also have uncertainty about government policies.

"We have some drafted policies, but are they implemented?"(KI-1)

Comparative analysis with other regions reveals both similarities and distinctions. Like Diyawadana et al. (2016) found in Hakwatuna-oya, Badulla farmers demonstrate strong climate perception but limited adaptation scope. However, where their study found 61% adoption of coping measures, our data shows higher awareness but more constrained action, likely due to limited institutional support in Badulla. Globally, the patterns resemble (Mertz et al. 2011) Sahel findings, where farmers react to observed changes rather than planning long-term, though Badulla's youth interest in technology offers a potential innovation pathway absent in other aging farming communities. Badulla farmers demonstrate sophisticated awareness of climate impacts through direct experience, but this rarely translates into transformative adaptation due to intersecting educational, financial, and institutional barriers. While perception is necessary for adaptation, it becomes sufficient only when supported by enabling systems that address these structural constraints. Future interventions must therefore move beyond awareness-raising to create holistic support systems that empower farmers to act on their knowledge, blending traditional wisdom with appropriate innovations for climate-resilient agriculture.

5.2 RQ2: Environmental and Demographic Factors Affecting Adaptation Strategy Effectiveness

The effectiveness of climate change adaptation strategies among Badulla District farmers is significantly shaped by both environmental conditions and demographic characteristics, as evidenced by this study's findings and supported by existing literature. The aging farming population mean age of 51.51 years(Table 2)with extensive traditional knowledge, an average of 22.96(Table 2) years of farming experience, demonstrating particular patterns of vulnerability and resilience that align with Nagamuthu (2024) findings in Northern Sri Lanka, that older farmers showed greater resistance to adopting new technologies despite their climate awareness. This demographic reality creates what Esham and Garforth (2013) the term "knowledge lock-in" where deep familiarity with traditional methods inhibits the adoption of potentially more effective climate-smart practices.

Educational achievement emerges as a critical factor mediating adaptation effectiveness, with only 2% (Table 4) of respondents having a tertiary education and 58% stopping at the secondary level(Table 4). This limited formal education correlates with what Deressa et al. (2009) observed in Ethiopia, where farmers' ability to interpret and act on climate information was strongly predicted by education level. The gender imbalance,84% male respondents (Table 3 and Figure 6), further compounds these result , as Sri Lanka women farmers often demonstrate greater adaptability but face systemic barriers in resource access(Herath &Thirumarpan 2017).

Economic factors create Significant distinctions in adaptive capacity. The wide income range from LKR 5,000-70,000 monthly (Table 2)reflects what Below et al. (2012) Identified as a key determinant of adaptation investment, households with greater financial resources can experiment with and sustain new practices. As KI-3 noted regarding unaffordable technology costs, even with subsidies, this aligns perfectly with Udmale et al. (2014) findings in Maharashtra about economic constraints limiting adaptation scope.

Environmental challenges interact dynamically with these demographic factors. Farmers' responses to erratic rainfall (reported by 72%) through crop switching mirror Williams and Carrico (2017) documentation of "flexible specialization" in Sri Lanka's dry zone. However, land tenure patterns (table 5)create unique constraints - while ownership might theoretically enable long-term investments, small plot sizes and fragmentation actually discourage them, as Marambe et al. (2015) found in their Sri Lankan studies.

The generational divide presents another critical dimension. Younger farmers' interest in technologies like protected agriculture contrasts with older generations' resistance to change, creating what Barnes et al.(2020) call an "adaptation gap" in their global study of agricultural communities. This is exacerbated by youth outmigration from farming, leaving adaptation efforts dominated by older, more conservative farmers.

Financial barriers prove particularly intractable, with 41.4%(Table 16) citing cost as a primary constraint. This supports Falco et al. (2011) microeconomic analysis showing how liquidity constraints prevent optimal adaptation even when farmers recognize climate risks. The 63% relying solely on farm income face compounded vulnerability, lacking the safety net that diversified households (26%) enjoy - a pattern also observed by Below et al. (2012) In their multi-country study.

These intersecting factors create a complex adaptation landscape where awareness doesn't automatically translate to effective action. The data suggests targeted interventions addressing specific demographic subgroups could be more effective than comprehensive approaches - for instance, financial instruments tailored to different income levels, or intergenerational knowledge-sharing programs as proposed by (Eriksen et al.2015).

Ultimately, these findings reinforce Khan et al.(2023) the argument is that climate adaptation requires understanding local socioeconomic contexts as much as environmental changes. For Badulla District, this means recognizing how its particular combination of aging farmers, educational gaps, economic disparities, and land tenure systems creates unique barriers to and opportunities for effective climate adaptation.

5.3 RQ3: The Interplay of Socioeconomic and Institutional Barriers in Climate Adaptation

Institutional factors play a crucial mediating role in the awareness-adaptation relationship. The findings reveal a critical disconnect between institutional support and farmers' adaptive capacity in Badulla District, shaped by socioeconomic constraints and systemic institutional gaps. While agricultural programs exist, they lack targeted climate adaptation strategies, leaving farmers to rely on fragmented and often inadequate support. This section synthesizes these challenges through the lens of institutional theory and socioeconomic barriers, demonstrating how they collectively hinder effective adaptation.

While the Agriculture Department serves as the primary advice source (65%), a concerning 24.2% of farmers never receive agricultural information. This implementation gap reflects what Agrawal (2008) identifies as weak "regulative pillars" in institutional systems - policies exist but fail at the delivery stage. The Crop Calendar's underuse exemplifies this, with farmers continuing to rely on traditional indicators despite having access to scientific forecasts. As one officer noted, "Many don't use websites or apps," pointing to digital literacy barriers in knowledge dissemination. The underuse of the Crop Calendar despite its potential benefits reflects what Agrawal (2008) identified as weak "regulative pillars" in institutional systems - policies exist but fail at implementation. Similarly, the gender imbalance in survey respondents (84% male) likely masks important gendered adaptation patterns that (Adger et al. 2009) argue are crucial for understanding true community resilience.

5.3.1 Institutional Gaps: Climate Adaptation as a Secondary Priority

Despite the presence of agricultural policies, climate adaptation remains peripheral in institutional support. As Interviewee 1 noted, "We don’t have specific programs that directly address climate change," highlighting a regulative gap where policies are either absent or poorly implemented. This aligns with Agrawal (2008) observation that weak enforcement mechanisms undermine institutional effectiveness.

The Crop Calendar, a key tool for climate-resilient farming, illustrates this gap. Although scientifically designed, its underutilization (only 17% adoption) stems from poor dissemination and lack of follow-up (KI-3). Farmers rely on word-of-mouth rather than digital platforms, reinforcing Grothmann and Patt, (2005) The argument that low "climate risk literacy" limits proactive adaptation. Additionally, institutional communication avoids framing strategies as climate-focused. As KI- 2 stated,

> "We don’t call it ‘climate adaptation say, ‘This will improve your yield.”(KI-2)

While this approach increases short-term compliance, it complicates the urgency of systemic adaptation, leaving farmers unprepared for long-term climate risks ((Barnes et al. 2020).

5.3.2 Socioeconomic Barriers: Financial and Generational Constraints

Financial instability is a major impediment to adopting climate-smart practices. Financial barriers prove particularly stubborn, with one interviewee explaining that

"Even with 50% subsidies, many farmers cannot afford the remaining costs" for technologies like drip irrigation. This economic reality forces what Williams and Carrico (2017) call "flexible specialization" - minor adjustments within existing systems rather than transformative change. This strengthening, Below et al. (2012), found that economic status mediates policy effectiveness. This creates an "adaptation poverty trap"(Khan et al. 2023) where only wealthier farmers invest in resilience. The generational divide compounds these challenges, as younger farmers show interest in innovations ("Young farmers call us about new technologies") while older generations "stick to what they know," creating what Esham &Garforth (2013)term "knowledge lock-in."

A generational divide further worsens this issue. While younger farmers show interest in innovations like protected agriculture, most lack capital or land access (KI- 1). Older farmers, meanwhile, resist change due to entrenched practices (Interviewee 3), reflecting (Esham & Garforth 2013) concept of "knowledge lock-in." This resistance is compounded by land fragmentation and delayed irrigation support (KI- 4), forcing farmers to prioritize short-term survival over long-term adaptation.

5.3.3 The Normalization of Institutional Gaps and Farmer Coping Mechanisms

Farmers have internalized these systemic failures, perceiving them as inevitable constraints. For instance, many dismiss the Crop Calendar due to inconsistent institutional follow-up, while others reject new technologies due to past experiences with poorly coordinated subsidies (KI- 3). This normalization aligns with Scott(1999) Cultural-cognitive pillar, where repeated institutional failures shape farmers' low expectations.

However, some farmers adapt within these limitations, e.g., shifting crop seasons or relying on peer networks. While these strategies offer temporary relief, they are insufficient against escalating climate risks (Adger et al. 2009).

The challenges facing Badulla farmers exemplify how institutional systems and socioeconomic realities interact to constrain climate adaptation. Through an institutional lens, we see how regulative failures in policy implementation, normative resistance to change, and cultural-cognitive gaps in risk perception create structural barriers that disproportionately affect resource-poor farmers. These institutional weaknesses intersect with and exacerbate socioeconomic constraints - particularly financial limitations and generational divides - creating what (Khan et al. 2023) term an "adaptation poverty trap." While some farmers develop coping mechanisms within these constraints, such localized adaptations remain insufficient against escalating climate risks(Adger et al. 2009). The findings underscore that transformative adaptation requires simultaneously addressing institutional gaps (through stronger policy enforcement and climate-focused programming) and socioeconomic barriers (via targeted financial support and intergenerational knowledge transfer). Only by reforming both the institutional architecture and the economic conditions that shape farmers decision-making can Badulla District build truly inclusive climate resilience.

while subjective norms are influenced by peer behaviour and extension advice. Perceived behavioural control is constrained by limited financial resources, lack of technical knowledge, and low trust in institutional forecasts, leading to reliance on low-cost, traditional strategies such as changing planting dates. Institutional Theory further explains these dynamics: the normative pillar (extension services and peer practices) supports familiar adaptations, but the regulative pillar (formal policy incentives, subsidies) and cultural-cognitive pillar (shared scientific understanding) remain weak, limiting the adoption of advanced, climate-smart technologies(Scott 1999).

The theoretical implications are significant. The institutional theory helps explain individual adaptation decisions - farmers recognize climate risks (attitudes), respond to peer and extension advice (subjective norms), but face constrained action due to financial/technical barriers (perceived control)(Dey &Singh 2023). Institutional Theory complements this by highlighting systemic failures - weak policy implementation (regulative), the importance of farmer groups (normative), and persistent skepticism toward scientific forecasts (cultural-cognitive). Together, these frameworks reveal why awareness alone cannot drive effective adaptation without addressing structural barriers.

These findings suggest several policy directions. First, climate communication must bridge local and scientific knowledge, perhaps through "climate analogies" connecting observed changes to broader patterns. Second, institutions require strengthening at implementation levels - the Crop Calendar could be paired with field demonstrations and localized training. Third, financial instruments need redesign to make subsidies truly accessible, potentially through staggered payment systems. Finally, youth engagement programs could leverage their technological interest to drive innovation adoption while preserving valuable traditional knowledge

5.3.4 Policy Implications: Bridging the Gaps

A comprehensive strategy must concurrently address socioeconomic constraints and institutional deficiencies in order to successfully increase farmers' adaptive ability. Integrating adaptation into year-round, required training programs should be the top priority for climate-specific institutional reforms, as opposed to seasonal workshops. Strong accountability systems should also be established to guarantee that policy implementation reaches the local level. For low-income farmers to have access to climate-smart technologies, financial and social interventions must include targeted support systems like microloans and tiered subsidies. These must be combined with the empowerment of farmer groups to act as adaptation advocates who can change community norms and practices. In order to ensure that suggestions are both practically applicable and scientifically valid, methods of communication must fundamentally change from top-down advisories to participatory, dialogue-based approaches that respect local expertise and enhance climate literacy.

Through demonstration farms, peer learning networks, and practical training that highlights the real advantages of climate-resilient agriculture, this multifaceted approach must also include focused efforts to change farmers' perspectives toward adopting new technologies, closing the gap between conventional methods and creative solutions.

6. Conclusion

This study underlines the significant disconnect between farmers in Badulla's understanding of climate change and their ability to respond effectively. Although the majority acknowledge that weather patterns are changing, their reactions are still confined to low-cost, short-term strategies rather than novel approaches. Systemic obstacles are the main cause of the problems: older farmers continue to use traditional methods, institutional support does not reach the most vulnerable, and financial limitations prohibit investment in cutting-edge technology.

Integrated solutions are necessary for the future. In order to make forecasts and advisories more approachable and useful, climate communication must first close the gap between scientific understanding and farmers' real-world experiences. Second, farmers can be empowered to embrace climate-smart practices through financial tools like microfinancing and structured subsidies. Third, in order to guarantee that policies are implemented in a way that is useful at the field level, agricultural institutions need to improve their public relations.

It is important that adaptation strategies maintain traditional wisdom while including younger generations. Though it needs to be supported with funding and training, the growing interest in technologies like protected agriculture holds promise for innovation.

When climate adaptation shifts from being a personal burden to a community obligation, backed by responsive institutions, equal resources, and common knowledge, true resilience will be achieved. Badulla can change its agricultural sector to resist climatic shocks and protect farmers' livelihoods for future generations by tackling these interrelated issues. Before the effects of climate change exceed the community's ability to adapt, systemic action is urgently needed.

References

Abeywardana, N., Schütt, B., Wagalawatta, T., Bebermeier, W., 2019. Indigenous Agricultural Systems in the Dry Zone of Sri Lanka: Management Transformation Assessment and Sustainability. Sustainability 11, 910. https://doi.org/10.3390/su11030910

Adger, W.N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L.O., Wolf, J., Wreford, A., 2009. Are there social limits to adaptation to climate change? Clim. Change 93, 335–354. https://doi.org/10.1007/s10584-008-9520-z

Agrawal, A., 2008. The Role of Local Institutions in Adaptation to Climate Change. World Bank, Washington, DC. https://doi.org/10.1596/28274

Ajzen, I., 2020. The theory of planned behavior: Frequently asked questions. Hum. Behav. Emerg. Technol. 2, 314–324. https://doi.org/10.1002/hbe2.195

Akhtar, R., Afroz, R., Masud, M.M., Rahman, M., Khalid, H., Duasa, J.B., 2018. Farmers' perceptions, awareness, attitudes, and adaption behaviour towards climate change. J. Asia Pac. Econ. 23, 246–262. https://doi.org/10.1080/13547860.2018.1442149

Alahacoon, N., Edirisinghe, M., Ranagalage, M., 2021. Satellite-Based Meteorological and Agricultural Drought Monitoring for Agricultural Sustainability in Sri Lanka. Sustainability 13, 3427. https://doi.org/10.3390/su13063427

Bambaradeniya, C.N.B., Edirisinghe, J.P., De Silva, D.N., Gunatilleke, C.V.S., Ranawana, K.B., Wijekoon, S., 2004. Biodiversity associated with an irrigated rice agro-ecosystem in Sri Lanka. Biodivers. Conserv. 13, 1715–1753. https://doi.org/10.1023/b:bioc.0000029331.92656.de

Barnes, M.L., Wang, P., Cinner, J.E., Graham, N.A.J., Guerrero, A.M., Jasny, L., Lau, J., Sutcliffe, S.R., Zamborain-Mason, J., 2020. Social determinants of adaptive and transformative responses to climate change. Nat. Clim. Change 10, 823–828. https://doi.org/10.1038/s41558-020-0871-4

Below, T.B., Mutabazi, K.D., Kirschke, D., Franke, C., Sieber, S., Siebert, R., Tscherning, K., 2012. Can farmers' adaptation to climate change be explained by socio-economic household-level variables? Glob. Environ. Change 22, 223–235. https://doi.org/10.1016/j.gloenvcha.2011.11.012

Bibi, F., Rahman, A., 2023. An Overview of Climate Change Impacts on Agriculture and Their Mitigation Strategies. Agriculture 13, 1508. https://doi.org/10.3390/agriculture13081508

Burchfield, E.K., Gilligan, J., 2016. Agricultural adaptation to drought in the Sri Lankan dry zone. Appl. Geogr. 77, 92–100. https://doi.org/10.1016/j.apgeog.2016.10.003

Chithranayana, R., Punyawardena, B., 2014. Adaptation to the vulnerability of paddy cultivation to climate change based on seasonal rainfall characteristics. J. Natl. Sci. Found. Sri Lanka 42, 119. https://doi.org/10.4038/jnsfsr.v42i2.6992

Creswell, J.W., 2004. Designing A Mixed Methods Study In Primary Care. Ann. Fam. Med. 2, 7–12. https://doi.org/10.1370/afm.104

Cuevas, S.C., 2018. Institutional dimensions of climate change adaptation: insights from the Philippines. Clim. Policy 18, 499–511. https://doi.org/10.1080/14693062.2017.1314245

Dasandara, M., Ingirige, B., Kulatunga, U., Fernando, T., 2023. Climate financing barriers and strategies: the case of Sri Lanka. J. Financ. Manag. Prop. Constr. 28, 242–259. https://doi.org/10.1108/jfmpc-12-2021-0069

De Zoysa, M., Inoue, M., 2014. Climate Change Impacts, Agroforestry Adaptation and Policy Environment in Sri Lanka. Open J. For. 04, 439–456. https://doi.org/10.4236/ojf.2014.45049

Department of Agriculture, Sri Lanka, 2023.

Department of Meteorology Sri Lanka, 2023.

Deressa, T.T., Hassan, R.M., Ringler, C., Alemu, T., Yesuf, M., 2009. Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. Glob. Environ. Change 19, 248–255. https://doi.org/10.1016/j.gloenvcha.2009.01.002

Dey, S., Singh, P.K., 2023. Estimating farmers' intention towards institutional credit adoption by using extended theory of planned behavior. J. Appl. Soc. Psychol. 53, 684–703. https://doi.org/10.1111/jasp.12952

Dharmasena, P.B., 2014. Current Status of Land Degradation in Badulla District.

Diyawadana, D.M.N., Pathmarajah, S., Gunawardena, E.R.N., 2016. Perception-driven coping strategies for climate change by smallholder farmers in Sri Lanka: a case study in Hakwatuna-oya major irrigation scheme. Trop. Agric. Res. 27, 336. https://doi.org/10.4038/tar.v27i4.8211

Eriksen, S.H., Jackson Inderberg, T.H., O'Brien, K., Sygna, L. (Eds.), 2015. Climate change adaptation and development: transforming paradigms and practices. Routledge, London. https://doi.org/10.4324/9781315774657

Esham, M., Garforth, C., 2013. Climate change and agricultural adaptation in Sri Lanka: a review. Clim. Dev. 5, 66–76. https://doi.org/10.1080/17565529.2012.762333

Esham, M., Jacobs, B., Rosairo, H.S.R., Siddighi, B.B., 2018. Climate change and food security: a Sri Lankan perspective. Environ. Dev. Sustain. 20, 1017–1036. https://doi.org/10.1007/s10668-017-9945-5

Falco, D., veronesi, M., yesuf, M., 2011. Does adaptation to climate change provide food security? A micro-perspective from Ethiopia. Am. J. Agric. Econ. 933 829-846
.

Feder, G., Feeny, D., 2022. Land Tenure and Property Rights: Theory and Implications for Development Policy.

food and agriculture Organization of the Uited Nation, n.d. Pro-Poor Policy Options: Empowering Poor Farmers in Sri Lanka.

Gnanasubramaniam, S., Hemachandra, D., 2020. Perception of Climate Change and Farmers' Adaptation: An Analysis for Effective Policy Implementation. Asia-Pac. J. Rural Dev. 30, 27–54. https://doi.org/10.1177/1018529120946177

Grothmann, T., Patt, A., 2005. Adaptive capacity and human cognition: The process of individual adaptation to climate change. Glob. Environ. Change 15, 199–213. https://doi.org/10.1016/j.gloenvcha.2005.01.002

Gunathilaka, R.P.D., Smart, J.C.R., Fleming, C.M., Hasan, S., 2018. The impact of climate change on labour demand in the plantation sector: the case of tea production in Sri Lanka. Aust. J. Agric. Resour. Econ. 62, 480–500. https://doi.org/10.1111/1467-8489.12262

Herath, H.M.L., Thirumarpan, K., 2017. Climate Change Induced Adaptation Strategies by Paddy Farmers: Special Emphasis on Socio Economic Insights. J. Agric. Sci. – Sri Lanka 12, 124–137. https://doi.org/10.4038/jas.v12i2.8230

Hussein, A., 2024. Climate smart agriculture strategies for enhanced agricultural resilience and food security under a changing climate in Ethiopia. Sustain. Environ. 10. https://doi.org/10.1080/27658511.2024.2345433

Jatav, H.S., Raiput, V.D., Minkina, T. (Eds.), 2025. Ecologically Mediated Development: Promoting Biodiversity Conservation and Food Security, Sustainable Development and Biodiversity. Springer Nature Singapore, Singapore. https://doi.org/10.1007/978-981-96-2413-3

Jayatissa, R., S.M. Moazzem Hossain, 2010. Nutrition and Food Security Assessment in Sri Lanka - 2009: BADULLA DISTRICT. https://doi.org/10.13140/RG.2.1.1316.0169

Khan, N.A., Chowdhury, A., Shah, A.A., Khan, P., Alotaibi, B.A., 2023. The institutional support index: A pragmatic approach to assessing the effectiveness of institutions' climate risk management support-A case study of farming communities in Pakistan. Clim. Risk Manag. 42, 100560. https://doi.org/10.1016/j.crm.2023.100560

Leiserowitz, A.A., Maibach, E.W., Roser-Renouf, C., Smith, N., Dawson, E., 2013. Climategate, Public Opinion, and the Loss of Trust. Am. Behav. Sci. 57, 818–837. https://doi.org/10.1177/0002764212458272

Maddison, D., 2007. The Perception Of And Adaptation To Climate Change In Africa. World Bank, Washington, DC. https://doi.org/10.1596/1813-9450-4308

Marambe, B., 2020. Agricultural Research for Sustainable Food Systems in Sri Lanka: Volume 1: a Historical Perspective. Springer Singapore Pte. Limited, Singapore.

Marambe, B., Punyawardena, R., Silva, P., Premalal, S., Rathnabharathie, V., Kekulandala, B., Nidumolu, U., Howden, M., 2015. Handbook of Climate Change Adaptation. Springer Berlin Heidelberg, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-38670-1_120

Marambe, B., Silva, P., Athauda, S., 2017. Agriculture and Rural Development Under Central Government and Provincial Council Setup in Sri Lanka, in: Decentralization and Development of Sri Lanka Within a Unitary State. pp. 126–129.

Marambe, B., Weerahewa, J., Dandeniya, W.S. (Eds.), 2020. Agricultural Research for Sustainable Food Systems in Sri Lanka: Volume 1: A Historical Perspective. Springer Singapore, Singapore. https://doi.org/10.1007/978-981-15-2152-2

Mertz, O., Mbow, C., Reenberg, A., Genesio, L., Lambin, E.F., D'haen, S., Zorom, M., Rasmussen, K., Diallo, D., Barbier, B., Moussa, I.B., Diouf, A., Nielsen, J.Ø., Sandholt, I., 2011. Adaptation strategies and climate vulnerability in the Sudano-Sahelian region of West Africa. Atmospheric Sci. Lett. 12, 104–108. https://doi.org/10.1002/asl.314

Ministry of Agriculture, 2020.

Moormakn, F.R., Panabokke, C.R., 1961. - ANEW APPROACH TO THE IDÊNTIfICATION AND aASSIFICATlON OF THf MOST IMPORTANT SOIL'GROUPS OF CEYLON 27–29.

Nagamuthu, P., 2024. The Impact of Climate change on Water Resources in Northern Sri Lanka: Stakeholder Perspectives. Vidyodaya J. Humanit. Soc. Sci. 09, 38–60. https://doi.org/10.31357/fhss/vjhss.v09i01.03

Navaratne, N.W.M.G.S., Wanigasundera, W.A.D.P., Alahakoon, P.C.B., 2019. Perceptions of Climate Change and Adaptation of Climate Smart Technology by the Tea Smallholders: A Case Study of Ratnapura District in Sri Lanka. Asian J. Agric. Ext. Econ. Sociol. 1–18. https://doi.org/10.9734/ajaees/2019/v36i330244

Pathiraja, Garry Griffith, Bob Farquharson, Rob Faggian, 2017. The Economic Cost of Climate Change and the Benefits from Investments in Adaptation Options for Sri Lankan Coconut Value Chains. International Journal on Food System Dynamics.

Ricart, S., Gandolfi, C., Castelletti, A., 2023. Climate change awareness, perceived impacts, and adaptation from farmers' experience and behavior: a triple-loop review. Reg. Environ. Change 23. https://doi.org/10.1007/s10113-023-02078-3

Scott, W.R., 1999. Institutions and organizations, Nachdr. ed, Foundations for organizational science. Sage, Thousand Oaks.

Scott, W.R., 1995. Institutions and organizations, Foundations for organizational science. SAGE, Thousand Oaks.

Shimola, K., Krishnaveni, M., 2013. On a Sustainable Future of the Earth's Natural Resources. Springer Berlin Heidelberg, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-32917-3_32

Siriwardana, C., Cooray, A.T., Liyanage, S.S., Koliyabandara, S.M.P.A., 2019. Seasonal and Spatial Variation of Dissolved Oxygen and Nutrients in Padaviya Reservoir, Sri Lanka. J. Chem. 2019, 1–11. https://doi.org/10.1155/2019/5405016

Sithumini, S.D.P., Udugama, J.M.M., Guruge, T.P.S.R., 2020. Farm-Level Adaptation to Climate Change and Impacts on Household Food Security: Evidence from the Dry Zone of Sri Lanka. J. Dry Zone Agric. 6, 105. https://doi.org/10.4038/jdza.v6i2.49

Thilakasiri, K.R., Kumara, G.M.P., Galagedara, L.W., Mowjood, M.I.M., 2015. Strategies to improve water productivity in small tank system: a case study from Kurunegala district in Sri Lanka. Trop. Agric. Res. 26, 684. https://doi.org/10.4038/tar.v26i4.8130

Udmale, P., Ichikawa, Y., Manandhar, S., Ishidaira, H., Kiem, A.S., 2014. Farmers′ perception of drought impacts, local adaptation and administrative mitigation measures in Maharashtra State, India. Int. J. Disaster Risk Reduct. 10, 250–269. https://doi.org/10.1016/j.ijdrr.2014.09.011

Uva Provincial Department of Agriculture,Annual Agricultural Report – Badulla District., 2023.

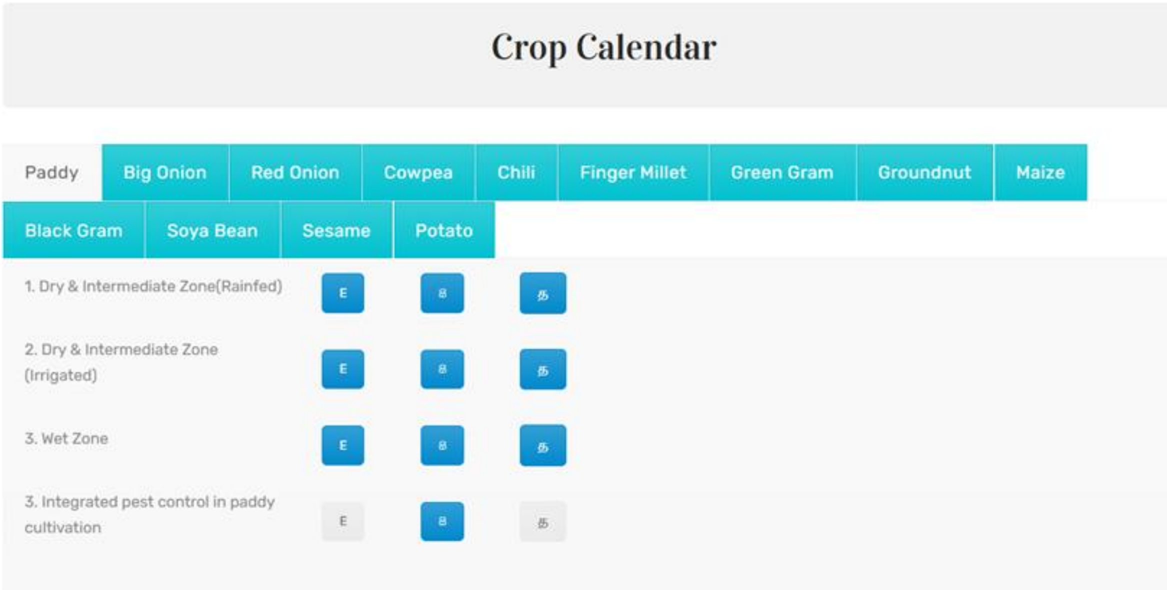
Uy, T.C., Limnirankul, B., Chaovanapoonphol, Y., 2015. Factors Impact on Farmers' Adaptation to Drought in Maize Production in Highland Area of Central Vietnam. Agric. Agric. Sci. Procedia 5, 75–82. https://doi.org/10.1016/j.aaspro.2015.08.011

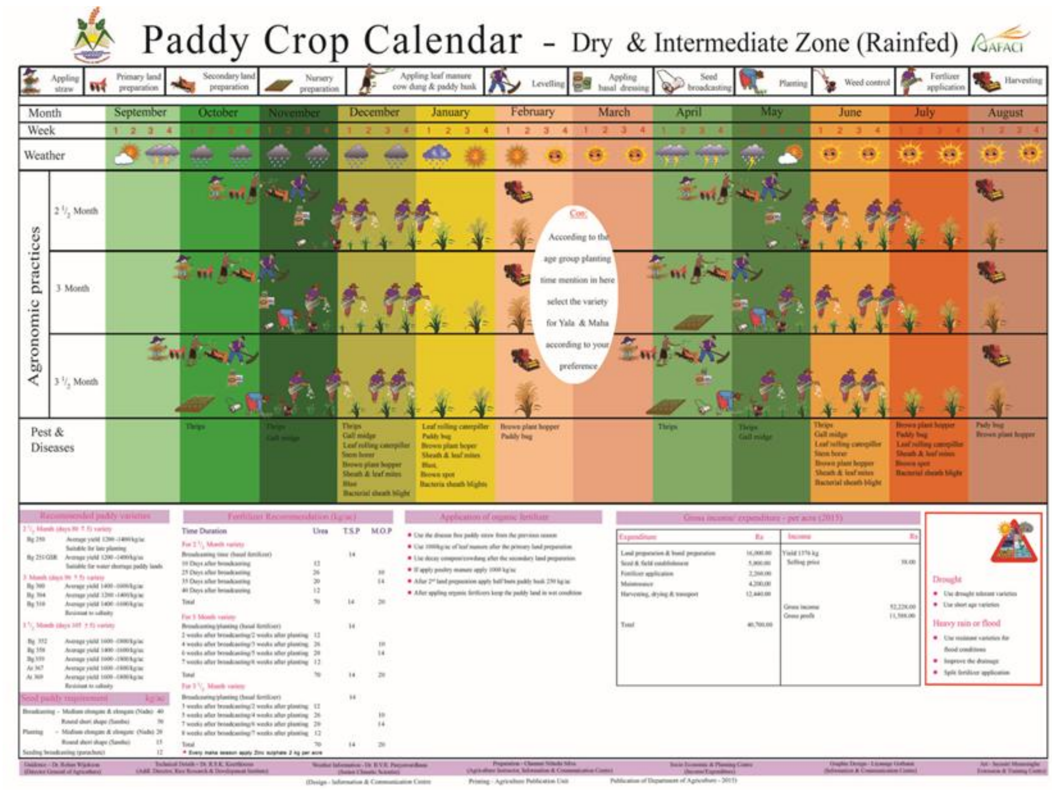
Vijitha, V., Sayanthan, S., Mikunthan, T., 2022. A Review on Rainwater Harvesting in Sri Lanka. Vavuniya J. Sci. 1, 31–37. https://doi.org/10.4038/vjs.v1i1.5

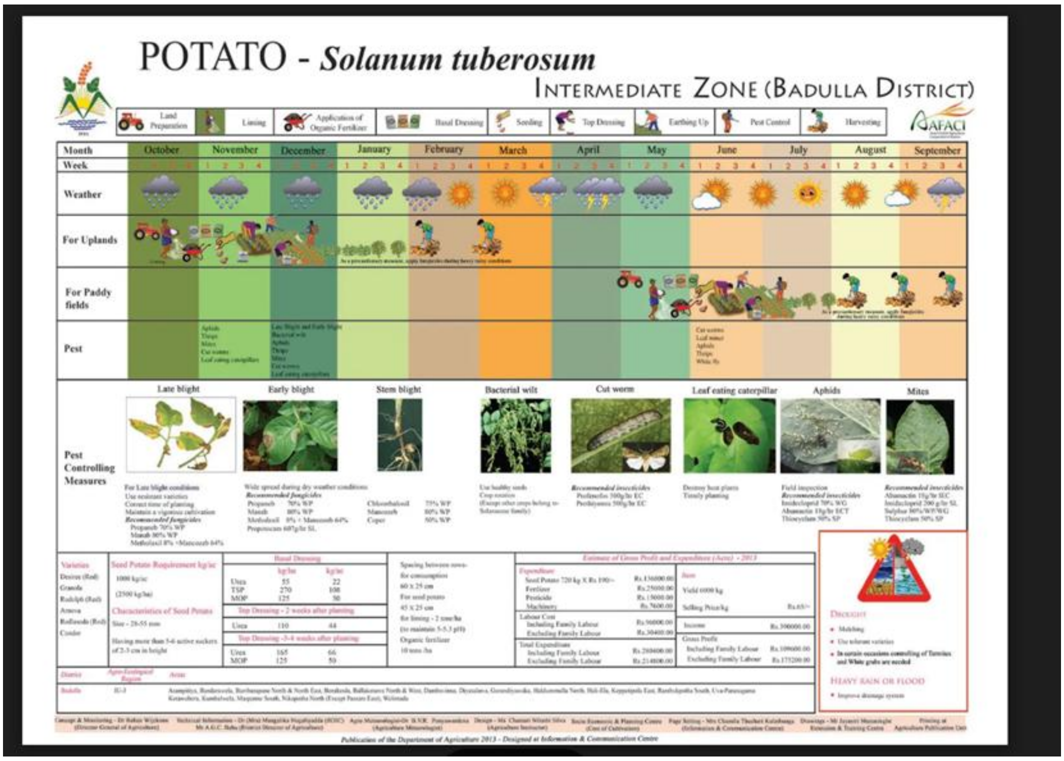
Williams, N.E., Carrico, A., 2017. Examining adaptations to water stress among farming households in Sri Lanka's dry zone. Ambio 46, 532–542. https://doi.org/10.1007/s13280-017-0904-z

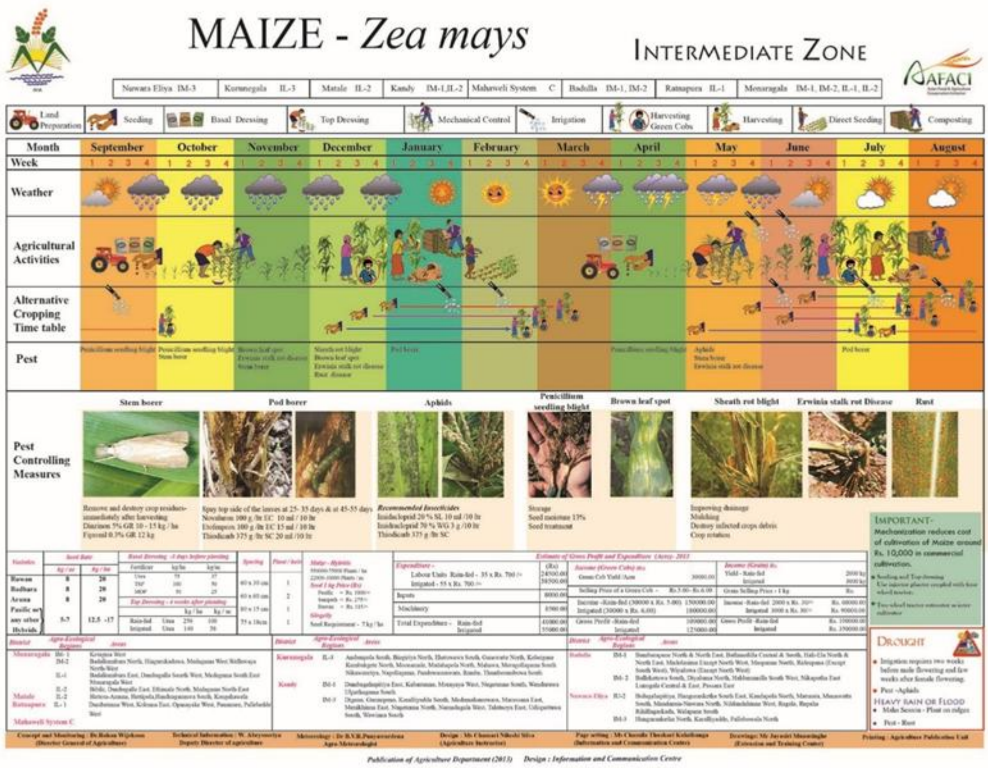
Appendix 1

Crop Calander






POTATO - Solanum tuberosum
INTERMEDIATE ZONE (BADULLA DISTRICT)
Month
Week
October
November
December
January
February
March
April
May
June
July
August
September
Weather
For Uplands
For Paddy fields
Pest
Pest Controlling Measures
Late blight
Early blight
Stem blight
Bacterial wilt
Cut worm
Leaf eating caterpillar
Aphids
Mites


MAIZE - Zea mays
INTERMEDIATE ZONE
Month
Week
September
October
November
December
January
February
March
April
May
June
July
August
Weather
Agricultural Activities
Alternative Cropping Time table
Pest
Pest Controlling Measures
Stem borer
Pod borer
Aphids
Penicillium seedling blight
Brown leaf spot
Sheath rot blight
Erwinia stalk rot Disease
Rust

Appendix 2

Entered Data into SPASS

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	Q1	String	40	0	Name	None	None	35	Left	Nominal	Input
2	Q2	Numeric	8	0	Age	None	None	8	Right	Scale	Input
3	Q3	Numeric	8	0	Gender	{1, male}...	None	8	Right	Nominal	Input
4	Q4	String	20	0	Village/Grama Niladhari Division	None	None	19	Left	Nominal	Input
5	Q5	String	22	0	Divisional Secretariat Division	None	None	19	Center	Nominal	Input
6	Q6	Numeric	8	0	Education level	{1, No schooling}...	None	19	Right	Nominal	Input
7	Q7	Numeric	8	0	Years of farming experience	None	None	14	Right	Scale	Input
8	Q8	Numeric	8	2	Size of landholding (in acres)	None	None	27	Right	Nominal	Input
9	Q9	Numeric	8	0	Land tenure	{1, Owned}...	None	8	Right	Nominal	Input
10	Q10	String	40	0	Main crops grown	None	None	27	Left	Nominal	Input
11	Q11	String	8	0	Livestock kept (if any)	None	None	13	Left	Nominal	Input
12	Q12	Numeric	8	0	Primary source of income	{1, Farming}...	None	8	Right	Nominal	Input
13	Q13	Numeric	8	0	Monthly income from agriculture (approx.)	None	None	8	Right	Scale	Input
14	Q14	Numeric	8	0	Household size	None	None	8	Right	Scale	Input
15	Q15	Numeric	8	0	Have you heard of the term "climate change"?	{1, Yes}...	None	8	Right	Nominal	Input
16	Q16	Numeric	8	0	If yes, how did you first hear about it	{1, TV/Radio}...	None	8	Right	Nominal	Input
17	Q17	Numeric	8	0	What do you believe are the main causes of climate change?	{1, Natural causes}...	None	8	Right	Nominal	Input
18	Q18	Numeric	8	0	Which of the following changes have you noticed in the past 10 years	{1, Temperature increase}...	None	8	Right	Nominal	Input
19	Q19	Numeric	8	0	Do you believe climate change is affecting farming in your area	{1, Yes}...	None	8	Right	Nominal	Input
20	Q20	Numeric	8	0	How confident are you in your knowledge about climate change	{1, Very confident}...	None	8	Right	Nominal	Input
21	Q21	Numeric	8	0	Has your crop yield changed over the past 5–10 years	{1, Increased}...	None	8	Right	Nominal	Input
22	Q22	Numeric	8	0	What factors do you think caused this change	{1, Rainfall variability}...	None	8	Right	Nominal	Input
23	Q23	Numeric	8	0	Have you experienced any crop or income loss due to climate-related events	{1, Yes}...	None	8	Right	Nominal	Input
24	Q24	String	100	0	If yes, please describe the event and the approximate loss incurred	None	None	54	Left	Nominal	Input
25	Q25	Numeric	8	0	Are there any crops you have stopped cultivating due to climate reasons?	{1, Yes}...	None	8	Right	Nominal	Input
26	Q26	String	30	0	If yes, which crops and why?	None	None	15	Left	Nominal	Input
27	Q27	Numeric	8	0	What practices have you adopted to reduce the impact of climate variability? (Tick all that apply)	{1, Crop diversification}...	None	8	Right	Nominal	Input
28	Q28	Numeric	8	0	Why did you choose these practices	{1, Own decision}...	None	8	Right	Nominal	Input
29	Q29	Numeric	8	0	How effective do you consider these practices	{1, Very effective}...	None	8	Right	Nominal	Input
30	Q30	Numeric	8	0	What barriers do you face in implementing adaptation strategies	{1, Lack of knowledge}...	None	8	Right	Nominal	Input
31	Q31	Numeric	8	0	Are you willing to adopt new climate-resilient practices if support is given	{1, Yes}...	None	8	Right	Nominal	Input

30	Q30	Numeric	8	0	What barriers do you face in implementing adaptation strategies	{1, Lack of knowledge}...	None	8	Right	Nominal	Input
31	Q31	Numeric	8	0	Are you willing to adopt new climate-resilient practices if support is given	{1, Yes}...	None	8	Right	Nominal	Input
32	Q32	Numeric	8	0	Have you ever received formal training on climate-smart agriculture	{1, Yes}...	None	8	Right	Nominal	Input
33	Q33	Numeric	8	0	Who provides you with farming advice or support	{1, Agriculture Department...	None	8	Right	Nominal	Input
34	Q34	Numeric	8	0	Do you have access to early warning systems (e.g., weather forecasts)?	{1, Yes}...	None	8	Right	Nominal	Input
35	Q35	Numeric	8	0	How frequently do you receive agricultural information?	{1, Weekly}...	None	8	Right	Nominal	Input
36	Q36	Numeric	8	0	Preferred source of information	{1, TV/Radio}...	None	8	Right	Nominal	Input
37	Q37	Numeric	8	0	What kind of support would help you most in adapting to climate change? (Rank or tick most n...	{1, Financial assistance}...	None	8	Right	Nominal	Input
38	Q38	Numeric	8	0	Are your practices documented (e.g., farm records, cropping calendar)?	{1, Yes}...	None	8	Right	Nominal	Input
39	Q39	Numeric	8	0	Do you use traditional knowledge in farming decisions	{1, Yes}...	None	8	Right	Nominal	Input
40	Q40	Numeric	8	0	Are you a member of any farmer organization or cooperative	{1, Yes}...	None	8	Right	Nominal	Input
41	Q41	String	30	0	If yes, name of organization	None	None	20	Left	Nominal	Input
42	Q42	String	50	0	What changes have you made in your farming in the past 5 years	None	None	27	Left	Nominal	Input
43	Q43	String	50	0	In your opinion, what is the biggest climate-related problem faced by farmers in your area	None	None	33	Left	Nominal	Input
44	Q44	String	40	0	What advice would you give to other farmers to cope with climate challenges	None	None	29	Left	Nominal	Input
45	Q45	String	200	0	Any other comments, suggestions, or expectations	None	None	70	Left	Nominal	Input

Appendix 3

Interview Questions for Agrarian Inspectors / Policy Makers)

Section 1: Background Information

1. Which **Divisional Secretariat (DS) Division** or **Agrarian Service Center (ASC)** do you work in?
2. What is your **official position and role** in agricultural development?
3. How many years of experience do you have in this field?

Section 2: Climate Change Awareness & Institutional Support

4. How does your institution support farmers in adapting to climate change?
5. What **policies or programs** are currently in place to assist farmers in Badulla District with climate adaptation?
6. How effective are these policies in **helping farmers cope with climate change**?

Section 3: Farmer Awareness & Information Access

7. In your opinion, how well do farmers in your region **understand climate change** and its effects on agriculture?
8. How do farmers typically receive **climate-related information** (e.g., government sources, media, training programs)?
9. Are there **training or awareness programs** available to educate farmers about climate change adaptation?

Section 4: Adaptation Strategies & Effectiveness

10. What are the most common **adaptation strategies** that farmers in this region use to cope with climate change?
11. Which adaptation strategies have been the **most effective**, and why?
12. What are the biggest **barriers preventing farmers** from successfully adapting to climate change?

Section 5: Policy Recommendations & Future Plans

13. What improvements do you think are needed in **current climate adaptation policies** for farmers?
14. What **future initiatives or programs** are planned to strengthen climate resilience in Sri Lanka's agricultural sector?
15. What is the **most urgent change** that needs to be made to improve climate adaptation in agriculture?

4. Farmer Questionnaire

Section 1: Demographic and Socioeconomic Information

1.Name (optional):
2.Age:
3.Gender: ☐ Male ☐ Female ☐ Other
4.Village/Grama Niladhari Division:
5.Divisional Secretariat Division:
6.Education level: ☐ No schooling ☐ Primary ☐ Secondary ☐ Advanced Level ☐ Tertiary
7.Years of farming experience:

8.Size of landholding (in acres):
9.Land tenure: ☐ Owned ☐ Leased ☐ Shared ☐ Other (specify):
10.Main crops grown:
11.Livestock kept (if any):
12.Primary source of income: ☐ Farming ☐ Non-farming ☐ Both
13.Monthly income from agriculture (approx.):
14.Household size:

Section 2: Awareness and Perception of Climate Change

1.Have you heard of the term "climate change"? ☐ Yes ☐ No
2.If yes, how did you first hear about it?
☐ TV/Radio ☐ Internet ☐ Newspapers ☐ Agricultural Officers ☐ Other farmers ☐ School
3.What do you believe are the main causes of climate change?
☐ Natural causes ☐ Human activities ☐ Both ☐ Not sure
4.Which of the following changes have you noticed in the past 10 years?
☐ Temperature increase
☐ Reduced rainfall
☐ Irregular rainfall
☐ Increased droughts
☐ Frequent floods
☐ New pests/diseases
☐ Other (specify):
5.Do you believe climate change is affecting farming in your area? ☐ Yes ☐ No
4.How confident are you in your knowledge about climate change?
☐ Very confident ☐ Somewhat confident ☐ Not confident

Section 3: Impacts of Climate Change on Local Agriculture

1.Has your crop yield changed over the past 5–10 years?
☐ Increased ☐ Decreased ☐ No change ☐ Not sure
2.What factors do you think caused this change?
☐ Rainfall variability ☐ Soil degradation ☐ Pest/disease pressure
☐ Input costs ☐ Market issues ☐ Others (specify):
3.Have you experienced any crop or income loss due to climate-related events? ☐ Yes ☐ No
4.If yes, please describe the event and the approximate loss incurred:
5.Are there any crops you have stopped cultivating due to climate reasons? ☐ Yes ☐ No
6.If yes, which crops and why?

Section 4: Climate Adaptation Strategies and Practices

1.What practices have you adopted to reduce the impact of climate variability? (Tick all that apply)
☐ Crop diversification
☐ Use of drought-resistant varieties
☐ Shifting planting/harvesting time
☐ Mulching or composting
☐ Rainwater harvesting

☐ Agroforestry
☐ Use of organic fertilizers
☐ Soil bunds or erosion control
☐ Irrigation changes
☐ Use of shade nets or tunnels
☐ Other (specify):
2.Why did you choose these practices?
☐ Own decision ☐ Advice from officers ☐ Observed others ☐ NGO/Govt project
3.How effective do you consider these practices?
☐ Very effective ☐ Somewhat effective ☐ Not effective ☐ Not sure
4.What barriers do you face in implementing adaptation strategies?
☐ Lack of knowledge ☐ Lack of money ☐ Limited access to inputs
☐ Labour shortages ☐ Land constraints ☐ Poor market access
☐ Other (specify):
5.Are you willing to adopt new climate-resilient practices if support is given? ☐ Yes ☐ No
If no, why not?

Section 5: Institutional Support and Information Access

1.Have you ever received formal training on climate-smart agriculture? ☐ Yes ☐ No
2.Who provides you with farming advice or support?
☐ Agriculture Department ☐ Extension Officers ☐ NGOs ☐ Farmer groups ☐ Private sector
3.Do you have access to early warning systems (e.g., weather forecasts)? ☐ Yes ☐ No
4.How frequently do you receive agricultural information?
☐ Weekly ☐ Monthly ☐ Occasionally ☐ Rarely ☐ Never
5.Preferred source of information:
☐ TV/Radio ☐ Internet ☐ Mobile phone (SMS/Apps)
☐ Agriculture extension officers ☐ Farmer meetings

6.What kind of support would help you most in adapting to climate change? (Rank or tick most needed)
☐ Financial assistance
☐ Technical training
☐ Improved seeds/inputs
☐ Timely weather info
☐ Policy support
☐ Market access
☐ Others (specify):

Section 6: Monitoring Current Agricultural Practices

Are your practices documented (e.g., farm records, cropping calendar)? ☐ Yes ☐ No
Do you use traditional knowledge in farming decisions? ☐ Yes ☐ No
Are you a member of any farmer organization or cooperative? ☐ Yes ☐ No
If yes, name of organization:
What changes have you made in your farming in the past 5 years?

Section 7: Open Feedback

In your opinion, what is the biggest climate-related problem faced by farmers in your area?

What advice would you give to other farmers to cope with climate challenges? Any other comments, suggestions, or expectatation

2.Request Letter to obtain Farmer List

02/05/2025

The Deputy Commissioner

Department of Agrarian Development

Badulla

Dear Sir,

Request for Access to Farmer Contact Details for Research Purposes

I am writing to kindly request your support in facilitating a research study titled "Assessment of Public Perception on Climate Change Adaptation Strategies in Local Agricultural Practices in the Badulla District".

The study aims to assess the awareness, perceptions, and adaptation strategies adopted by farmers in response to climate change, with a specific focus on local agricultural practices in the Badulla District. It involves a field survey to be conducted with a representative sample of 100 farmers across different agricultural zones in the district.

In order to proceed with the survey efficiently and ensure adequate representation, we respectfully request access to the farmer contact details (including names, locations, and contact numbers) available in the farmer database maintained by your Department. The information will be used solely for academic and research purposes, and all collected data will be treated with strict confidentiality.

I would be most grateful for your permission to access this information or to coordinate with your officers to identify suitable farmers for participation in the study.

Thank you very much for your kind consideration and continued support.

Yours Sincerely,

Dr. Nuwan Weerawansha
Senior Lecturer
Department of Export Agriculture
Faculty of Animal Science and Export Agriculture
Uva Wellassa University of Sri Lanka

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