

Executive Summary

Overview of the Study

Climate change increases temperature and precipitation variability globally, causing climate shocks such as droughts and floods, which negatively affect economic activities and quality of life. Low- and middle-income countries (LMICs) are particularly vulnerable to climate change, facing more risks of reduced agricultural productivity, food security crises, labor force losses, the spread of tropical diseases, and an increase in climate-induced refugees. Many LMICs rely heavily on agriculture for their economies, and farmers in LMICs have limited information and resources to respond to climate changes, which exacerbates the damage caused by climate change. This dynamic could intensify inequalities and undermine multiple dimensions of human well-being.

The Mekong River Basin, spanning six countries—Vietnam, Laos, Cambodia, Thailand, Myanmar, and China—is Asia’s largest trans-boundary river system. It provides agricultural, industrial, and domestic water resources to over 90 million people, including the Mekong Delta, one of the world’s most significant rice-producing regions. However, the basin is located in a monsoon climate zone, characterized by high annual rainfall variability. It is particularly vulnerable to climate change, with more frequent and severe climate disasters such as droughts, floods, and saline intrusion expected.

Given this context, the study aims to comprehensively examine the impacts of climate change in the Mekong River Basin, where high agricultural dependence and limited capacity magnify climate-related risks. Specifically, it investigates the determinants of farmers’ adoption of climate adaptation measures and evaluates the multidimensional impacts of these measures. This study seeks to identify effective adaptation strategies for farmers to address the global challenge of

climate change and provide policy insights to enhance climate resilience in the agricultural sector, thereby supporting the development of international cooperation models.

The objectives of this research include: (1) Conducting interdisciplinary, evidence-based climate change research; (2) Strengthening research capacity in LMICs; (3) Developing and disseminating evidence-based climate change response strategies; (4) Identifying and proposing effective international development cooperation models for climate change adaptation. Through these efforts, the study aims to offer practical policy recommendations to farmers and policymakers in climate-vulnerable LMICs. To achieve this, the study focuses on three key research areas: The impacts of climate change on agricultural productivity and variability, and the effectiveness of adaptation measures; The factors of farmers' decision-making in adopting climate change adaptation measures; The effects of climate change adaptation measures on farmers' quality of life.

(Sub-study 1) The Impacts of Climate Change on Agricultural Productivity and Variability, and the Effectiveness of Adaptation Measures

Sub-study 1 examines the impact of climate change on agricultural productivity, profitability, and variability, as well as the effectiveness of adaptation measures, using micro-level data from Vietnamese farmers, historical climate records, and future climate projections. It analyzes how climate change affects agricultural productivity, profitability, and variability, and explores how these changes influence farmers' decisions to adopt adaptation measures, such as crop selection and machinery investments. Additionally, it assesses the impact of climate change and farmers' adaptation measures on rice productivity and agricultural income, with a focus on neighborhood effects.

Climate change significantly affects rice productivity and farm profitability. Substantial increases in temperature reduce both productivity and profitability, while also decreasing the variability of rice yields. In contrast, increased rainfall

raises variability of rice productivity, and both factors contribute to increased variability of farm profitability. Extreme weather events exacerbate rice productivity and its variability, with the Mekong Delta region being particularly vulnerable in terms of variability of rice yields.

In response to climate change, Vietnamese farmers tend to increase the proportion of rice cultivation. Simulations based on future climate scenarios suggest that the shares of rice and fruit crops will rise, while the shares of other food crops, vegetables, and industrial crops will decline. Lower carbon mitigation efforts are associated with a greater increase in the proportion of rice cultivation. Climate change also influences machinery expenditure, with a consistent rise in per-unit-area machinery expenditure across various climate scenarios.

The analysis of rice productivity, incorporating adaptation measures such as increased rice cultivation area and higher machinery investments, shows that rising temperatures and rainfall negatively impact rice productivity. Extreme weather events further reduce yields. However, adaptation measures improve productivity, highlighting their potential as effective responses to climate change. Without adaptation, rice productivity is projected to decline significantly, with losses exceeding 40% under the SSP5-8.5 scenario by 2061–2080. Implementing adaptation measures could mitigate these losses or even result in productivity gains, reducing losses to around 5% when all forms of adaptation measures are implemented. The effects of these adaptation measures were more pronounced in scenarios with lower carbon emission reduction efforts. These measures are particularly crucial in the Mekong Delta, where is more vulnerable to climate change compared to other areas.

Higher temperatures and increased rainfall negatively affect agricultural income, though the magnitude of income loss is smaller compared to rice productivity loss. This is due to the offsetting effects of climate change on different crops and the positive impact of higher market prices resulting from reduced productivity. Nonetheless, climate change tends to reduce agricultural income. Adaptation

measures, particularly adjusting crop shares, can lead to income growth. Neighborhood effects highlight the spillovers of adaptation, where climate impacts and adaptation decisions by neighboring farms influence others, potentially amplifying effects (multiplier effects). Future climate simulations suggest that, although income losses are smaller than productivity losses, long-term reductions in income are likely without adaptation. This is likely due to heterogeneous responses between crops (diversification effects) and price effects results from market price changes caused by climate change. Furthermore, if farmers implement adaptation measures, agricultural income can improve in the long term, with changes in crop composition having the greatest impact on farm profitability. When all adaptation measures are implemented, profitability could increase by up to 9%. In particular, in the Mekong Delta region, adaptation measures could boost farm profitability by up to 50%, and adjusting crop composition is expected to play a crucial role in responding to climate change.

The findings suggest several policy implications. First, rice productivity is expected to decline, particularly in the Mekong Delta. To address this, climate change adaptation measures at the farm level, such as changes in crop composition and mechanization, need to be encouraged with policy support for drought and flood mitigation, crop variety improvement, and climate disaster prevention. Second, the impact of climate change on agricultural income from crop farming is relatively smaller than the reduction in rice productivity. This is because agricultural income focuses on income rather than productivity per unit area. The increase in market prices due to the reduction in productivity positively affects profitability, which partially offsets the negative impact of climate change on productivity. Nevertheless, climate change tends to worsen farm profitability. However, agricultural income may actually increase when farmers implement adaptation measures such as changing crop combinations and increasing investment in agricultural machinery. Therefore, education and financial support for crop change and infrastructure investment at the farm level are crucial. Third, the neighborhood effects, which represent the social effect between neighboring farmers in crop selection, were

found to be significant. This suggests that changes in crop selection and the formation of specialized production zones for specific crops create positive spillover effects, and education and training on crop selection can lead to positive externalities. Furthermore, regionally organized community-based programs are likely to deliver effective effective outcomes.

(Sub-study 2) The Factors of Farmers' Decision-Making in adopting climate change adaptation measures among Mekong River Basin Farmers

Sub-study 2 conducts a survey targeting farms in the Mekong Delta of Vietnam and the Mekong River Basin of Laos to analyze the factors influencing farms' decisions to implement climate change adaptation measures. Climate change responses are broadly categorized into adaptation and mitigation measures, with low- and middle-income countries mainly relying on adaptation measures due to limited climate change response capacity. Key climate change adaptation measures in agriculture include (1) adjusting cultivation schedules, (2) crop diversification, (3) changing seed varieties, (4) preparing agricultural land, (5) adjusting cultivation techniques, (6) managing water usage, (7) improving water infrastructure, (8) diversifying income sources, and (9) utilizing agro-climatic information. These adaptation measures serve as crucial strategies for farmers in the Mekong River Basin to effectively respond to climate change. The countries in the Mekong River Basin, in collaboration with international development cooperation programs like DeRisk South Asia, SAMIS, and LaCSA, provide government-led climate information services to enhance farmers' climate change response capabilities. These initiatives have improved access to farming techniques and information, contributing to strengthening farmers' climate change response capacities.

This study aims to analyze various factors influencing the decision-making process for implementing climate change adaptation measures by farms in the Mekong Delta of Vietnam and the Mekong River Basin of Laos. The goal is to understand the decision-making mechanisms behind the adoption of adaptation

measures and to propose effective policies and strategies for improving farmers' climate change adaptation capacity, which can contribute to increased agricultural productivity, food security, poverty alleviation, and improved quality of life, ultimately contributing to sustainable agriculture and rural development.

The household surveys were conducted through one-on-one face-to-face interviews in collaboration with local partners in Vientiane Province, Laos (308 households), and Tien Giang Province, Vietnam (319 households) in June and September 2024, respectively. The Vietnam survey built a panel data set based on a follow-up survey conducted in the same region in 2022.

The key dependent variables include (1) adoption of individual climate change adaptation measures, (2) adoption of adaptation measure groups classified by similar characteristics, and (3) climate change adaptation index, which measures the overall tendency to utilize climate change adaptation measures. Climate change adaptation measures are classified based on similar characteristics into categories such as (4) variety/crop diversification, (5) adjusting farming practices, (6) water use management/infrastructure improvements, (7) climate information utilization, (8) income diversification, and (9) insurance purchase. The climate change adaptation index was estimated using Principal Component Analysis (PCA). The main explanatory variables include demographic variables, socio-economic variables, access to climate information, resource and technical factors, climate change perception and damage experience, adaptation measure perception, social networks, and non-cognitive skills that may influence farmers' decisions to adopt climate change adaptation measures.

Survey results show that the majority of farmers in Vietnam and Laos recognized that climate change is occurring and had experienced damage from floods or droughts. Additionally, they anticipated future climate shocks such as droughts or floods due to climate change. Although most households had a positive perception of climate change adaptation measures, relatively fewer households actually utilized climate information in their adaptation efforts.

In terms of the current status of climate change adaptation measure adoption by farmers, Vietnam primarily adopted (4) agricultural land preparation, (5) adjustment of cultivation techniques, (9) utilization of agro-climatic information, and (7) individual water infrastructure improvements. In contrast, Laos mainly adopted (1) adjusting cultivation schedules, (3) changing seed varieties, (5) adjusting cultivation techniques, and (9) utilizing agro-climatic information. Both countries showed similar proportions of households possessing knowledge how to implement climate change adaptation measures and the actual adoption rates, but Vietnam exhibited a lower adoption rate relative to its knowledge compared to Laos.

The analysis of factors influencing the adoption of climate change adaptation measures by farmers in the Mekong River Basin revealed that no common factors universally affected the decision-making for all measures. However, agricultural extension services, access to agro-climate information, and self-efficacy were identified as key influencing factors.

These findings provide the following implications. First, to promote the adoption of climate change adaptation measures by farmers, policy support is needed to improve climate change-related knowledge and perception, support practical access to climate information, provide incentives to utilize this information, and identify and remove barriers. Second, education and training programs linked with agricultural extension services should strengthen farmers' climate-smart agricultural techniques and their implementation capabilities for adaptation measures. Third, it is essential to design regionally organized support measures tailored to farmers' non-cognitive skills, such as self-efficacy, and the characteristics of adaptation measures to effectively induce behavioral changes for adopting climate change adaptation measures. Fourth, efforts to enhance the climate change response capacities of LMICs should be strengthened through cooperation with various international development cooperation programs that utilize agro-climatic services.

(Sub-study 3) The Effects of Climate Change Adaptation Measures on Farmers' Quality of Life

Sub-study 3 aims to comprehensively analyze the various impacts of climate change adaptation measures on farmers' quality of life. Climate change has complex effects on the lives of farmers in LMICs, particularly threatening agricultural productivity and food security in the Mekong River Basin, thereby lowering the overall quality of life of farmers. Therefore, it is necessary to analyze the impact of climate change on various aspects of quality of life, such as income, consumption, and health, in addition to agricultural productivity. This provides an in-depth understanding required for establishing effective climate change response policies that can improve farmers' quality of life.

This study analyzes the effects of climate change adaptation measures on various aspects such as household income, agricultural income, household consumption expenditure, food consumption expenditure, and subjective quality of life, among farmers in the Mekong River Basin of Vietnam and Laos. By comparing the quality of life outcomes between farmers who adopted adaptation measures and those who did not, the study sheds light on the multidimensional effects of climate change adaptation measures. Using household survey data collected from Vietnam and Laos, the study employs methods such as Multiple Ordinary Least Squares regression, Panel Fixed-Effects analysis, and Endogenous Switching Regression (ESR) to estimate the impact of climate change adaptation measures on farmers' quality of life while mitigating biases caused by endogeneity. The study also examines how climate information services contribute to enhancing farmers' climate response capacities and alleviating the negative impacts of climate change through synergy effects with other adaptation measures.

The results show that in Laos, climate change adaptation measures had various effects on household income, consumption expenditure, and subjective quality of life. Adjusting farming practices showed positive effects by increasing household income and consumption expenditure, while income diversification enhanced

household income and optimism about future life. The use of climate information contributed to increasing household and agricultural incomes. On the other hand, the income-increasing effects of variety and crop diversification and water resource management were minimal, and insurance purchase was associated with income reduction and high anxiety about the future. The combination of climate information utilization and adjusting farming practices demonstrated effective synergies in increasing agricultural productivity and income. These results suggest that some adaptation measures, such as changing cultivation schedules or more actively utilizing climate information in agriculture, which can be implemented with relatively low costs and risks while maintaining the overall framework of current agriculture, may be more effective compared to high-cost and high-risk measures such as water resource management or variety and crop diversification.

In Vietnam, the ESR analysis results indicated that most climate change adaptation measures, except for insurance purchases, had positive effects on increasing household and agricultural incomes, and also showed positive effects in terms of household consumption expenditure, which well reflects the living standards of households. However, in terms of nutrition (food consumption expenditure) and subjective quality of life (satisfaction with current life and optimism about future life), different effects could be observed depending on the characteristics of the various types of climate change adaptation measures. This suggests that it is necessary to formulate and implement agricultural support policies and projects considering the objectives and characteristics of the target groups. It was also confirmed that in the case of insurance purchases, which might not directly increase current household income and agricultural income, there is a possibility that short-term negative impacts such as insurance premiums for insurance enrollment or moral hazards caused by insurance enrollment adversely affected household and agricultural incomes.

The key implications derived from this study are as follows. First, for farmers in LMICs with limited climate change response capacities, low-cost and low-risk

adaptation measures such as adjusting farming practices, utilizing climate information, and diversifying income sources, which have relatively low costs and difficulty of implementation, can be effective in improving the welfare and quality of life of farmers. Therefore, it is necessary to promote the active use of such adaptation measures by farmers, while high-cost and high-risk measures should be supported at the governmental or community level rather than at the individual farm level. Second, as agricultural extension services and access to finance have positive effects on increasing farmers' incomes, policies are needed to enhance farmers' capacities through community-based agricultural extension services and improve financial accessibility. Third, utilizing climate information is an important tool that can strengthen farmers' climate change response capacities and create synergy effects when combined with other adaptation measures, thus allowing farmers to respond more effectively to climate change. Therefore, policies to improve access to climate information services and provide technical support and capacity-building to actively utilize these services in agricultural activities are needed.

Proposal of a Sustainable International Development Cooperation Project Model

This study proposes a digital-based climate-smart agriculture international development cooperation project model, considering the long-term international development cooperation policies of the Korean government in the agriculture and climate change sectors, as well as the agricultural and climate change-related development strategies of Vietnam and Laos. Through this, the study seeks to promote sustainable agricultural and rural development and present guidelines applicable to the international development cooperation projects of the Korean government in these fields.

Vietnam has established a national strategy focused on agricultural digitization and technological innovation to respond to climate change in the agricultural sector. This policy aims to increase agricultural productivity and minimize the damage caused by climate change. Laos also has set the establishment of a

sustainable agricultural system and the enhancement of food security as the main goals of its national agricultural development strategy, implementing policies to strengthen the climate change adaptation capacity of rural areas.

By strengthening global networks and cooperation, we propose the following strategies to respond to the global challenge of climate change and improve global climate change capacities. First, we suggest to link with the Mekong Delta Region Development Policy Operation (Mekong DPO) project in Vietnam. A project to 'Increase Income through Improvement of Agricultural Product Distribution Systems' can be promoted in connection with the coastal road construction project in Tien Giang Province, involving the Asian Development Bank (ADB) and Korea Export-Import Bank for Mekong DPO. By utilizing the road being constructed, this project can be promoted to establish an agricultural product distribution system and form an agricultural value chain, enabling synergy effects through the linkage of grants (aid funds) and loans (non-aid funds) and the development of the BOP (Bottom of the Pyramid) market through private sector participation. Second, we propose to collaborate with the Asian Mega-Deltas (AMD) initiatives, being led by the Consultative Group on International Agricultural Research (CGIAR), for climate information projects such as 'Climate Change Resilience through the Automation of an Integrated Climate Change Information System.' Similarly, a digital platform providing agro-climatic information can be established in vulnerable areas such as the Mekong River Basin and central highlands to strengthen the climate change response capacity of the agricultural sector.

In addition, the following ODA models can be promoted in Vietnam and Laos respectively. In Laos, the advantages of agro-meteorological services such as SAMIS and LaCSA, which have already achieved significant results, can be utilized, and their limitations can be complemented to promote the nationwide expansion of these services. Alternatively, climate information services can be provided to climate-vulnerable areas, and regional tailored approaches can be considered to enhance the climate-smart agriculture capacity of farms and expand technical support. In Vietnam, while agro-meteorological services like DeRISK have made

meaningful contributions to the agricultural sector and received positive evaluations from the Vietnamese government, stable service provision is challenging without additional external support. Therefore, to provide long-term financially, technically, and capacity-wise sustainable climate information services, we suggest to develop a national-level Agro-Climatic Digital Platform (ACDP) that integrates data and information from various sources to provide services to farms. For the successful establishment and operation of the ACDP, it is necessary to prepare a technical foundation for development and maintenance, establish an effective delivery system for climate information and services, and create a systematic capacity-building program for system operation and utilization.

In promoting such ODA models in the agricultural and climate change sectors, we recommend the following considerations. First, the participation of vulnerable groups such as small farmers, women, youth, elderly, and disabled should be considered throughout the planning, implementation, and evaluation stages of a project. This ensures that the public objectives of ODA projects are achieved and that the project's outcomes are equitably distributed to vulnerable groups. Second, the active participation of local communities and farmer organizations should be encouraged to strengthen the capacity for self-reliance and sustainable project. Third, it is necessary to actively utilize the participation of the domestic private sector in Korea, with its technological capabilities and expertise. This can create new business opportunities such as exploring the BOP market, ensure the financial and economic sustainability of the project, and promote mutual development and co-prosperity between donor and recipient countries. Furthermore, cooperation between private sectors in Korea and partner countries can contribute to new market creation and the enhancement and development of local private sector capabilities. This approach will help achieve the public objectives of ODA projects in a sustainable manner while contributing to the mutual development of Korea and its partner countries.