

**Abstract of PhD Thesis Submitted by Ms Kyawt Yin Min Thein**

**titled**

**"CLIMATE VULNERABILITY REDUCTION FOR SMALL AND MARGINAL FARMERS IN UTTARAKHAND, INDIA"**

Climate change poses serious threats to rural livelihoods, particularly for small and marginal farmers living in fragile ecosystems such as the hilly regions of Uttarakhand, India. These communities face multiple stressors, including erratic rainfall, frequent landslides, flooding, and soil erosion, all of which exacerbate livelihood insecurity. Recognizing this, the present study investigates how farm households perceive and respond to climate-related risks, and how their adaptive capacity can be strengthened through sustainable agricultural practices. The study applies a mixed-methods approach that combines quantitative and qualitative research. Household survey data were collected from 367 households in Bageshwar district, Uttarakhand, covering socio-demographic profiles, livelihood strategies, health, food security, water resources, exposure to natural hazards, and adaptation barriers. Two established frameworks were employed to assess climate vulnerability: the Livelihood Vulnerability Index (LVI) and the Climate Vulnerability Index (CVI), both adapted to local conditions using 42 context-specific indicators. Additionally, the Garrett Ranking Technique (GRT) was used to rank key problems and barriers faced by farmers in implementing adaptation strategies. Focus group discussions, key informant interviews, and stakeholder consultations further enriched the analysis with qualitative insights. The findings demonstrate variations in vulnerability across villages. According to the LVI, Wali village (0.093) is the most vulnerable, followed by Pali (0.073), while Ason (-0.01) is the least vulnerable. The CVI results, however, show relatively similar values, with Ason village (1.056) being the most vulnerable, followed by Pali (1.014) and Wali (1.007), the least vulnerable. These differences highlight the importance of using multiple indices for assessing vulnerability, as each captures distinct dimensions of household exposure, sensitivity, and adaptive capacity. Determinants of adaptation were further examined using logistic regression analysis, revealing that education significantly influences the adoption of improved crop varieties, farm experience enhances adaptation, migration patterns shape diversification choices, and market distance negatively affects the uptake of sustainable practices. Land constraints emerged as a major barrier to crop rotation and diversification. Collectively, these results underscore the central role of socio-economic characteristics, institutional access, and infrastructural limitations in shaping climate resilience. Building on these insights, the study proposes a framework for sustainable agricultural practices tailored to the hilly regions of Uttarakhand. The framework integrates crop diversification, organic farming, agroforestry, permaculture, integrated pest management, and

conservation tillage. It also emphasizes institutional support, market access, low-cost technologies, and gender-sensitive interventions. By linking farmer-driven practices with enabling policies, the design provides a roadmap for strengthening resilience while addressing both ecological sustainability and livelihood security. The research also identifies key challenges and limitations. Limited geographical coverage restricts the generalizability of results, and cross-sectional data may not fully capture seasonal or long-term adaptation dynamics. Structural factors such as government subsidies, national climate policies, and global market fluctuations were not directly modeled, though they are influential. Despite these limitations, the study provides a robust empirical foundation for understanding vulnerability and adaptation in mountain agriculture. In terms of policy implications, the study highlights the need for capacity-building programs, targeted subsidies, improved rural infrastructure, and accessible extension services. Investments in climate-resilient seeds, insurance schemes, and community-based adaptation initiatives are essential. Furthermore, migration-sensitive policies should enable remittance investment in farming, while gender-responsive approaches are needed to ensure equitable access to resources and decision-making. In conclusion, this dissertation contributes to both academic and policy discussions on climate change and rural livelihoods. By applying and comparing the LVI and CVI frameworks, it advances methodological approaches to vulnerability assessment. By analyzing determinants of adaptation, it deepens understanding of the socio-economic and institutional drivers of resilience. Finally, by proposing a sustainable agricultural framework, it offers practical pathways for empowering small and marginal farmers to cope with climate risks in Uttarakhand and similar hilly regions