博士論文題目： Assessing Financially Sustainable Renewable Energy Technologies Utilization in Agricultural Communities in Rural Thailand (タイ農村部の農業コミュニティにおける財政的に持続可能な再生可能エネルギー技術の利用評価)

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The integration of Renewable Energy Technology (RET) in agriculture is crucial for achieving energy security, economic resilience, and poverty reduction. Renewable sources like solar, wind, and biomass serve as sustainable alternatives to fossil fuels, particularly benefiting farmers in remote areas with limited access to traditional power grids. This shift not only promotes energy independence but also substantially reduces operational costs for farmers, offering a more accessible and environmentally friendly energy source. The transition to self-sufficient renewable energy allows farmers to lower operational costs, emphasizing the substantial impact of renewable energy in agriculture.

Financial sustainability in renewable energy projects, particularly in agriculture, is achieved when the generated revenue covers all project costs, encompassing capital, operational, maintenance, and financing expenses. The decreasing prices of RET enhance the cost-effectiveness, making these projects more accessible for agricultural communities. Attaining financial sustainability is crucial, indicating a viable model that can be replicated in other communities, fostering widespread adoption of financially sustainable practices, and expanding the benefits of renewable energy in agricultural countries.

Community Renewable Energy (CRE) involves locally developed, owned, and controlled energy projects utilizing renewable sources like solar, wind, biomass, or hydropower. In small agricultural communities, primarily rural and engaged in farming, CRE brings benefits such as increased community engagement, ownership, access to modern technologies, and enhanced energy independence. Active community participation in planning and decision-making fosters a strong sense of ownership and cohesion, empowering residents and reinforcing community bonds. Ultimately, integrating CRE in small agricultural communities significantly contributes to their resilience and long-term growth.

However, the utilization of RETs in rural agricultural communities is currently inefficient, resulting in poor economic performance. This dissertation addresses this challenge by exploring solar energy applications, specifically the Greenhouse Solar Dryer (GSD) for thermal use and the Solar Water Pump (SWP) for electricity. The primary objective is to assess if small-scale agricultural communities in rural Thailand can achieve financial sustainability through these RETs, focusing on case studies of GSD and SWP systems and determining if the generated revenue can cover all associated costs, enabling self-sustainability and scalability without continuous financial assistance.

This dissertation begins by examining the implementation of CRE projects in Thai communities. It then explores the practical applications of solar energy technologies in agricultural communities,

specifically the GSD and the SWP. Initially, it focuses on enhancing the GSD's utilization rate, followed by addressing potential barriers to the adoption of SWP systems, which involves a two-step process to assess factors influencing investment willingness and explore potential business models for optimizing SWP system use. The findings highlight key factors for successful CRE projects, including a strong leader, formal structure, and external support. Shared GSD enhances utilization and profits but requires benefit-sharing strategies and intelligent unit support. SWP is well-accepted in drought-affected areas, with farmers willing to pay, especially in water-scarce regions. However, SWP adaptation necessitates loan schemes, leasing programs, and security insurance. The dissertation concludes by showcasing how SWP technology aids grass cultivation for increased profits in drought-prone regions, stressing the importance of comprehensive risk assessment. Overall, it underscores the benefits of promoting renewable energy among farmers and the critical need for technical and financial support systems to effectively overcome implementation challenges and fully exploit the advantages of these technologies.

This dissertation underscores three crucial factors for ensuring the financial sustainability of agricultural communities in rural Thailand through renewable energy. Firstly, community scale and cooperation significantly influence project utilization rates, crucial for developing profitable business models. Secondly, supporting these communities through financial mechanisms, such as loans or leasing programs, is essential for the widespread RETs adaptation. Thirdly, establishing a sufficient income stream from the community is necessary, and achievable through a well-devised business plan with appropriately sized technology. Additionally, factors like renewable energy resources, technology maturity, effectiveness, and the surrounding support structure play pivotal roles in enhancing project financial sustainability. While the first three factors are crucial, the latter four further contribute to improving the projects' financial sustainability.

This dissertation holds significance for offering insights into achieving financial sustainability through renewable energy in agricultural communities, benefiting not only rural Thailand but also aligning with essential factors for financial sustainability in developing agricultural nations. It contributes to improving economic conditions and enhancing the quality of life for farmers, providing valuable insights for policymakers, researchers, and practitioners. Additionally, its applicability to other nations positions the Thai case as a model for similar communities globally, influencing society and the economy on both national and global scales.