

## Abstract

Many developing countries have tried to solve issues such as poverty and electricity access with varying degrees of success. Up until 2014, China, the largest developing country, had a massive population living in poverty and lacking a stable electricity supply. In 2014, China launched the so-called "targeted poverty alleviation policies" ("精准扶贫"), which aimed to eliminate extreme poverty by 2020. In this thesis, we explore the Solar Energy for Poverty Alleviation Program (SEPAP), one of China's targeted poverty alleviation policies. Between 2014 and 2020, China constructed and operated 26.49 GW of solar PV systems for poverty alleviation, benefiting 1,472 counties, 138,093 villages, and 4.18 million poor households (National Energy Administration, 2020b).

However, there is still some uncertainty over how to evaluate SEPAP's actual effects. This thesis aims to evaluate SEPAP comprehensively, including its design, implementation, and impacts on poor households. The main research question is whether SEPAP has actually benefited the poor, and if yes, how. To answer the main research question, we have conducted the following three studies that evaluate SEPAP from governance, economics, and sustainability perspectives. The three studies correspond to Chapters 4, 5, and 6 in the dissertation.

First, based on the results from 30 semi-structured interviews with village leaders and local government officials in Jinzhai County, China, we have explored in depth the four types of SEPAP and the stages of SEPAP's development. In addition, we have examined five issues associated with the implementation of SEPAP in Jinzhai County, including poor building quality and poor maintenance. We find that the local government has actively collaborated with both higher levels of government and poor households to solve some of these issues.

Secondly, we have conducted a cost-benefit analysis of SEPAP in the case study of Jinzhai County. Our results demonstrate that SEPAP has provided certain economic benefits to poor households from 2014 on. However, can the poverty alleviation effects be sustained over time as they depend on providing substantial government funding. By conducting a scenario analysis to compare SEPAP with ordinary solar power plants, we

find that the poverty alleviation effects stemming from using solar power persist even without government subsidies. Nevertheless, in the midst of the Covid-19 period in 2020 and 2021, there was a rise in the initial cost, which resulted in a decrease in the net present value (NPV). Consequently, it is advisable to consider government subsidies for both the grid benchmark price and initial installation cost in future instances like this.

Thirdly, based on the results of 80 semi-structured interviews with professionals and poor households, we apply the Analytic Hierarchy Process (AHP) and the Fuzzy Comprehensive Evaluation Method (FCEM) to evaluate the sustainability of individual-level SEPAP in Jinzhai County, China. We find that the economic dimension is the most important, with income, employment, training of the poor, and solar panel quality as the most weighted sub-indicators. As a result of SEPAP, the income of poor households increased by around 2,700 yuan in 2021, which was 90% of the government's goals. We have also provided two policy recommendations for maintenance work that will assist the poor in keeping a stable income.

Finally, we discuss future solar energy development in rural areas in China and other developing countries. As for China, we suggest that policymakers should apply the agrivoltaics model and that policy regulations should be enforced with a consistent subsidy scheme in place. A hybrid business model should also be developed to promote future rural development.

As for other developing countries, it is important to recognize that there is no "one-size-fits-all" system, as SEPAP may not be suitable for other countries due to their unique local conditions. However, valuable lessons can be learned and adopted from SEPAP experiences. Firstly, it is necessary to identify all the poor households and understand their true needs. Then, rules and regulations must be established for program implementation. Furthermore, other poverty alleviation programs should be combined with the solar energy program in order to reduce the inherent disadvantages of the solar energy program.