Empirical Analyses of Energy Poverty at the Household Level

伊川, 萌黄

（様式２）

氏　　名　：伊川　萌黄
論 文 名　：Empirical Analyses of Energy Poverty at the Household Level
（エネルギー貧困の世帯レベル実証分析）
区　　分　：甲

論　文　内　容　の　要　旨

Energy poverty (EP) is defined as the situation where people cannot access clean and affordable energy services at a socially sufficient level. Chapter 1 discusses that EP has been mainly analyzed in the two currents of literature separately: one has been researched in development studies as the accessibility problem, and the other in sociology focuses on heating affordability problems of European countries. Due to this separate development of the literature in particular regions, few studies investigating EP from a global perspective and less evidence in summer-related EP.

In order to fill this gap, this thesis conducts one qualitative review and three empirical analyses on EP from a global and climate perspective. First, to comprehensively understand how EP can be quantified with quantifiable indicators, Chapter 2 describes EP indicators developed in both contexts of low-income and high-income countries. While these EP indicators have been developed from separate currents in low-income countries and high-income countries, this chapter finds common natures regarding the difficulty of identifying EP and the necessary viewpoints for understanding EP more reliably.

Based on the comprehensive understanding of EP indicators, Chapter 3 analyses EP using a survey conducted in 37 countries. These countries include all continents and various economic levels, which enables us to present a global overview of EP at the household level in relation to macro-economic factors and different dimensions of EP. Employing a three-level hierarchical model, we find that EP of country-average households in the accessibility and reliability dimensions shows an improving trend with economic development. The affordability dimension is the worst in countries with a middle level of economic development and greater income inequality. In addition, we find that a higher economic development level and larger income inequality are the most relevant factors in the strong negative association between households' low incomes and EP.

Chapter 4 shifts the focus from the globe to Japan. Japan has essential characteristics of EP contexts. Compared to other high-income countries where EP studies have been conducted, Japan's hot climate and high prevalence of Air-Conditioners offer a suitable environment for analyzing EP in summer contexts. This chapter shows the overall situation of EP in the summer seasons in Japan. Using machine learning methods, we show that behavioral and psychological factors are also associated with EP in addition to general socio-economic and housing factors employed in the literature. Interestingly, energy-efficient systems installed at home are more associated with the subjective indicator than the objective indicator. These results conclude that both the objective and subjective EP indicators capture different aspects in various EP dimensions.

Going beyond quantifying EP, assessing how EP affects human well-being is crucial. Using the same survey of Japan with Chapter 4, Chapter 5 analyses how cooling energy needs in the hot summer

season affect human well-being in relation to income level. Specifically, this chapter examines how much energy consumption increases in response to higher temperatures in the summer season and how the additional energy needs for indoor cooling, in turn, affects subjective well-being (SWB). The results confirm that higher cooling energy needs can reduce SWB. In relation to income level, the lowest-income group faces the highest cooling energy needs, presumably due to lower energy efficiency in housing. In contrast, the negative effect of cooling energy needs on SWB is the largest for the middle-income group. This contradictory finding implies that behavioral aspects matter for the evaluation of SWB.

Chapter 6 concludes that EP, especially in the affordability dimension of the summer season, will become more and more critical as the world economy develops. We note that improving energy efficiency in houses and appliances for lower-income households is essential for a fairer transition to more sustainable systems.