■受領№1359（中間報告）

Before and After 手法による東南アジアにおける非電化地区への再生可能エネルギー導入の住民生活に与える影響に関する研究

“Before and After” Study on the impacts of the electrification by renewable energy on villagers' QOL in rural areas in ASEAN

代表研究者
大垣　英明　京都大学エネルギー理工学研究所　教授

1. 研究目的

In 2020, around 850 million people worldwide are still facing insufficient access to electricity, most living in rural areas of developing countries. Although grid extension is considered a conventional way of improving access to electricity, it is often excessively costly. In contrast, renewable energy (RE), in particular, solar technologies, is more accessible and has opened new possibilities to supply power via off-grid systems in rural electrification projects. On a techno-economic basis, the impact of rural electrification can be associated with the scheme adopted. Grid extension is usually considered the best option as it guarantees a continuous supply with high power capability, but numerous studies have also demonstrated the feasibility of rural electrification using individual solar home systems (SHSs) or centralised (mini-grid) systems. On the other hand, the impact of electrification on human well-being and quality of life (QoL) remains vastly unexplored. In general, electrification is considered to bring positive changes to rural communities with improved health, income, education opportunities, and so on, all assumed to improve QoL. However, the existing investigations tend to concentrate on the QoL impact of rural electrification through indirect indicators, such as infant mortality, life expectancy, mean years of schooling, gross domestic product, gross national income, water access, and so on. In contrast, less research exists using measures reflecting the everyday experiences from electrification and its subjective appraisal.

We commissioned the present project with the main objective of investigating the effects on QoL before and after electrification in underserved communities in Myanmar, Cambodia, and Malaysia. First, different rural electrification schemes (grid extension, SHS, mini-grid system) are locally implemented in four villages in these countries.

2. 研究内容

Four villages typical of rural Southeast Asia were selected for the study. The selection was based on the premise of no official electrification at the time of selection (in some cases, there were plans to expand the grid or to power with off-grid systems) and the willingness of the community to take part in the project. The sites are Kampung Sungai Merah and Menangkin in Malaysia, Oak Pho in Myanmar, and Thmor Keo in Cambodia. All of them have income levels below the national average, and have similar economic activities, largely based on farming and fishing. Finally, with

the exception of Oak Pho (Myanmar), the first visits to villages were carried out prior to electrification, while the second visit was done at least one year after electrification.

2.1 Methodology

The QoL measurement is comprised of several domains through field work, providing two sets of data. The first survey captures the condition prior to electrification, and then the second survey was conducted around one year after electrification so as to allow some time for the villagers to adapt to the new lifestyle. Each of these measures are taken as baselines and endpoints, and with further analysis based on statistical methods, differences between both stages were revealed. The questionnaire was applied in the form of an interview. It was structured to cover QoL with its dimensions, occupation, and time of activities, as shown in Table 1. The measures are based on a well-known measure of quality of life known as the Wisconsin Quality of Life Index (WQoLI). The original elements in the WQoLI are life satisfaction, occupational activities, psychological well-being, physical health, social relations, economics, daily living activities, symptoms, and goals, from which we selected items with a rational hypothetical connection with electricity. In this process, we have examined previous literature reporting on relationships between the elements and electricity use.

2.2 Results

The interview data was analysed by SPSS statistical package and the demographics of sample data were balanced number of genders and ages. Most respondents completed primary education, were married and lived together with their family, declared farming as their main occupation, and their incomes were lower than each national average.

Overall, there was an increase in the levels of self-reported QoL. Figure 1 shows, as an example, how the median score in the 10-point scale item rose after electrification in all types of electrification systems. Given that QoL

No.	Category	Dimensions	Domains	Items	Type of Variable
I	Demographics	-	(1) Gender, (2) age, (3) education, (4) family type, (5) occupation	5	Nominal
II	Quality of Life	Quality of life (Self-reported and satisfaction sub-domains)	Self-reported quality of life	1	Ordinal (10p scale)
			Satisfaction sub-domains: (1) Time use, (2) time alone, (3) housing, (4) cooking, (5) personal safety	5	Ordinal (5p-likert scale)
		Psychological well-being	Self-reported mental health	1	Ordinal (5p-likert scale)
		Physical health well-being	Self-reported physical health	1	Ordinal (5p-likert scale)
		Social well-being	Perception on social support from family and friends	1	Ordinal (5p-likert scale)
		Economic well-being	(1) Feelings about personal wealth, (2) regularity of lack of money preventing activities, (3) income	3	Ordinal (5/4p scale)/Scale
III	Occupations	-	Satisfaction with (1) main activity, (2) hours of work	2	Ordinal (5p-likert scale)/Scale
IV	Time of activities	-	Total active time	1	Time scale

Table 1. Questionnaire items and structure

distributions were found to be left-skewed, a median test confirmed that the increase observed in the mini-grid system, the greatest among the systems, was significant ($X2 = 13.1$, $p < 0.05$). Nevertheless, the QoL median levels for the grid and SHS systems clearly demonstrate an increase, providing further support to the overall hypothesis that higher QoL levels were brought about by electrification. One of the main drivers for the advancement in QoL is the power and energy capacities offered to the different rural communities. Concerning this, the grid should offer the highest QoL advancement owing to its ability to deliver the highest power and energy capacities, and thus offering the highest flexibility in the choice of appliances and simultaneous operation of appliances, followed by the mini-grid system and the SHS. However, the results showed that the hybrid system recorded the highest self-reported QoL advancement, surpassing the grid and SHS. We conclude that the significant increase in self-reported QoL in the hybrid system in Oak Pho, Myanmar can be attributed to the severe state of deprivation of electricity before being formally electrified in comparison with Kampung Sungai Merah and Menangkin running on SHS and grid, where villagers in the two sites were already running diesel generators prior to electrification. With these results, it can be said that electrification had positive effects on human well-being, as seen through the use of this more direct measure.

In addition to the self-reported QoL, psychological, physical, and social well-being levels increased after electrification. In contrast, a certain reduction in economic well-being levels was also observed. This would be correlated with the analysis data that indicated no increase on

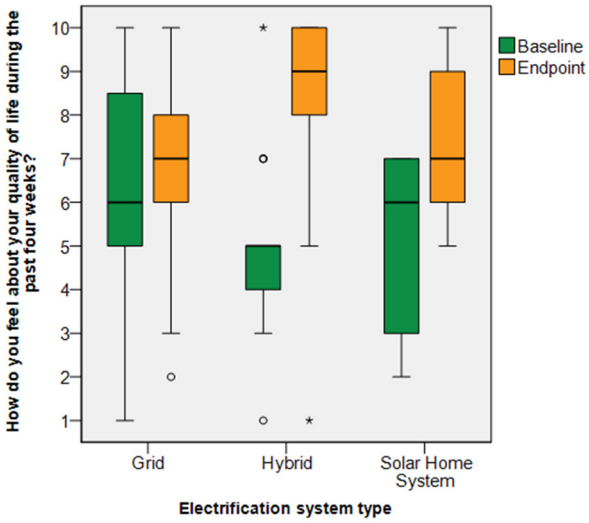

Fig. 1 Boxplots of self-reported quality of life (QoL)

productive activities and a decline in available household budget. For the more detail, satisfaction levels with time use, time spent alone, housing, and personal safety were no changes after electrification, and a positive effect on satisfaction levels with cooking. Moreover, in terms of occupation, no changes in the total hours dedicated to work and no prolonged active time on usual activities in the household were observed. Overall, the findings provide support to the hypothesis of a positive effect on QoL from electrification, but they also detail a more precise description of the effect on specific QoL dimensions, which clarifies facts presumed by indirect economic or aggregated measures.

From a technological systems viewpoint, the rural electrification scheme did not show important differences between systems beyond the prices paid for electricity, which were in general higher for the grid and mini-grid systems over the SHS. Problems arising from system management and maintenance, as well as post-operation waste management, might later become an issue because this result is based on the one-year perspective and longer-span observation should be needed to

complement them.

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