ASEAN Journal of Management & Innovation
Vol. 4. No. 2, 1 – 8

DOI: 10.14456/ajmi.2017.16
ajmi.stamford.edu

Study on Quality of Life Change for Rural Community through Rural Electrification by Renewable Energy: Preliminary Result

Hideaki Ohgaki
Institute of Advanced Energy, Kyoto University, Japan
ohgaki.hideaki.2w@kyoto-u.ac.jp
Hooman Farzaneh
Institute of Advanced Energy, Kyoto University, Japan
hooman.farzaneh.2v@kyoto-u.ac.jp
Nasrudin Abd Rahim
UM Power Energy Dedicated Advanced Centre, University of Malaya
nasrudin@um.edu.my
Hang Seng Che
UM Power Energy Dedicated Advanced Centre, University of Malaya
hsche@um.edu.my
Mohd Amran Mohd Radzi
Department of Electrical and Electronic Engineering, Universiti Putra Malaysia, Malaysia
amranmr@upm.edu.my
Wallace ShungHui Wong
Faculty of Engineering, Computing and Science, Swinburne University of Technology Sarawak Campus, Malaysia
wwong@swinburne.edu.my
Lai Chean Hung
Faculty of Engineering, Computing and Science, Swinburne University of Technology Sarawak Campus, Malaysia
clai@swinburne.edu.my

Abstract
Change in the energy usage pattern and the quality of life (QOL) before and after electrification of rural villages under different rural electrification schemes are being studied to access the significant achievement of rural electrification. Several rural villages in Sarawak, Malaysia, have been identified, where some of the villages are remained in non-electrified conditions mainly due to their remote geographical location. We have selected four Iban communities with different rural electrification plans, so far. Interview based study has been carried out since 2016. A preliminary result of a survey on QOL for 33 villagers from 20 to 71 years old indicated that 90% villagers are satisfied with their lives. 1. They are in good health

both in physically and in mentally. However, personal activities are at very low level, because their access to transportation is very poor. The project has just been started and SHSs installation in one village will be finished soon. The other village will be electrified by the grid extension. We will monitor the villagers' energy usage patterns and QOLs under the different electrification schemes. The project outcome will contribute to establishing the methodology of renewable energy implementation and to the social acceptance of renewable energy.

Keywords: Renewable Energy. Lifestyle, Quality of Life (QOL), Sarawak, Rural Electrification

1. Introduction

Energy is indispensable for the development of human society (e.g., IEA, 2002 and UNDP, 2005). In this line, "Energy for all" (IEA, 2011) is issued and adopted as Goal 7 in Sustainable Development Goals (SDGs), because there are 1.06 billion people, predominantly rural dwellers, still function without electricity (UN, 2017). To provide basic household electricity with renewable energy (RE) systems, such as solar home systems (SHSs), is considered one of the solutions in remote villages where the grid power is not economically feasible. However, a fair number of the rural electrification projects have been observed to be unsustainable, due to various reasons (e.g., Urmee T, 2016). One of the reasons would be that the projects tend to address the supply side issues, rather than to improve productivity and income of the rural communities. The evaluation of World Bank rural electrification projects found little evidence of direct impact on income generation or economic growth (World Bank, 2008.). The other example of the highly successful SHS program had only modest impact on the villagers' income generation (e.g., Rahman SM and Ahmad MM, 2013).

Therefore, it is important to study the impacts of the electrification in rural communities, and many studies have been performed starting from the grid power extension scheme (e.g., Barns D.F., 2014, Brassley P., 2017) to renewable energy schemes (e.g., UNEP, 2006). However, there are not many numbers of studies on the impacts in villagers' lifestyle and economic "before and after" their electrification that will bring more clear information on the impacts of electrification. Therefore, we have started the project aims to study the energy usage pattern and lifestyle "before and after" rural electrification for a rural community in interior Sarawak, Malaysia since 2016. Malaysia, as one of the leading developing nations in South East Asia, has been enjoying a good coverage of electricity compared to her neighboring countries. Nevertheless, the electricity coverage has not been equal throughout the country. In 2009, the electricity coverage in the state of Sarawak was approximately 67%, which is relatively lower than the Peninsular Malaysia (99.5%) and the state of Sabah (77%) (Fadaeenejad M., 2014).

According to the data published under the Government Transformation Plan (GTP), Malaysia government aims to increase the electricity coverage in Sarawak from 82.7% in 2012 to 95% by 2015. In line with this effort, Sarawak Energy Berhad (SEB), the state utility, has been responsible for improving the electricity coverage in Sarawak, including the implementation of small-scale rural electrification projects using hydro-diesel and solar-diesel hybrid system (van Gevelt et al., 2017), with varying degrees of success.

Several rural villages in Sarawak have been identified for this project, where some of the villages received electrifications via renewable energy sources, (particularly SHSs), some are in the process of being electrified through grid extension, while some others remained non-electrified due to their more remote geographical locations. These villages are chosen based on their accessibility, co-cooperativeness and the potential for electrification to study the impact on the energy usage pattern and QOL by the different electrification schemes (such as a grid extension scheme and SHSs scheme).

We have interviewed four villages in Sarawak so far and are planning to extend our study sites to increase the monitor samples and to include the other renewable implementation scheme villages as well as different countries, Myanmar and Cambodia. This paper report on our preliminary result of QOL survey on four villages before different electrification schemes in Sarawak, Malaysia. Based on the findings on the differences and similarities between the energy usage pattern and QOL of the villages under different rural electrification schemes, more effective approach to implementing rural electrification can be deduced.

2. Methodology

To measure the lifestyle of the rural villagers, a face-to-face interview based investigation has been carried out in this study. The concept of the quality of life (QOL) and the energy usage pattern are used to quantify the villagers' lifestyle. In general, QOL is measured by health, education, personal activities, political voice and governance, social connections, environmental conditions, personal insecurity (J. E. Stiglitz, 2009). We have been using the Wisconsin QOL indicators (M.A. Becker, 2014) as the questionnaire which consists of "General Satisfaction Level", "Activities and Occupations", "Psychological Well-Being", "Symptoms/Outlook", "Physical Health", "Social Relations/Support", "Money", "Activities of Daily Living", "Goal Attainment".

The system model developed to assess QOL in this research is depicted in Figure 1.

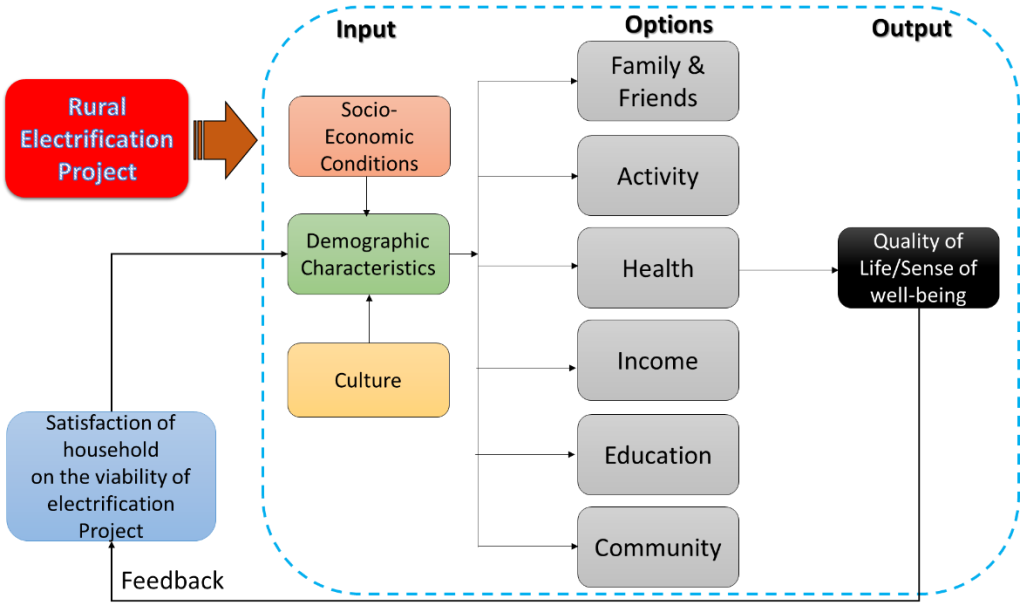

Figure 1: System model developed to access QOL in this research

We also added some energy-related questions, such as electrical appliances, current electricity condition, daily energy usage pattern, energy demands, to assess the villages' energy access improvement. The external conditions of the village, such as transportations, schools, hospitals, also recorded. Figure 2 depicts the procedure of this research. As shown in fig. 2, we plan to design and implement a renewable energy system based on the energy demand, renewable energy resource condition, and available budget, if the villages have no ongoing plan of electrification. The implementation of the renewable energy system will be reported in our future paper. The villagers' interview will be continued to study how their QOL will be changed after different electrification schemes. At the end of the research project, we will analyze the result of the interviews to find differences and similarities between the energy usage pattern and QOL of the villages under different rural electrification schemes and more effective approach of implementing rural electrification will be proposed.

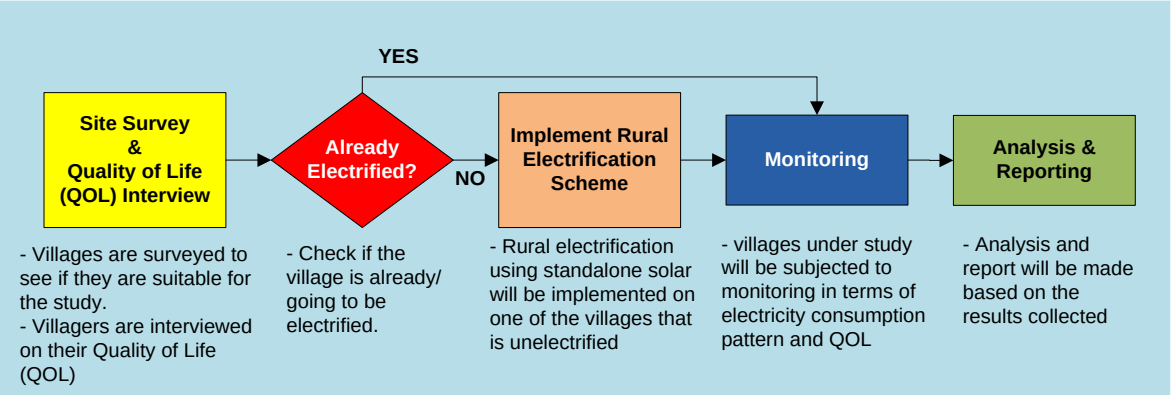

Figure 2: Procedure of the research

Iban Community

The Iban is the largest indigenous group in the state of Sarawak, Malaysia, constituting approximately 29% of the total population. Though modernization had driven many of the Iban to gain their living in the urban areas, there are still some communities that stayed in the rural areas of Sarawak, defending their traditional lifestyle as animistic farmers and forest gatherers. One unique feature of the Iban community is their close-knitted society, evidenced by the tradition of staying in the *rumah panjang*, i.e. longhouse, which can be regarded as a village under one roof (Taschi Tsering Sim, 2014). A longhouse usually consists of multiple compartments, also known as *pintu*, each of which houses an Iban family, all banded together under the leadership of a *tuai rumah*, or village head. While traditional longhouse can have several tenths of families, modern Iban village usually consists of several units of smaller longhouses, while maintaining the *tuai rumah* culture. So far, four Iban villages have been surveyed, namely Menangkin, Tabong, Jenggin and Kampung Sungai Merah.

Figure 3: Location of the studied villages

Figure 4: Electrification scheme of studied villages

Figure 3 shows the location of these villages and their electrification schemes are shown in Figure 4.

3. Preliminary Result and Discussion

The face-to-face interviews have been conducted with 33 villagers, ranging from 20 to 71 years old from April 2016, to February 2017. The local language was used during the interview sessions. Based on the survey conducted so far, the following findings have been made on the villagers' QOL:

- Most of the villagers (75%) have received education only up to primary school level

-Their incomes are lower than average (RM 3,831/month) and about 60% villagers are satisfied with their condition (Fig. 5)

- 90% villagers are satisfied with their lives (Fig. 6)

- They emphasize on the importance to connect with neighbors, and are in good health/mental conditions.

- Personal activities, i.e. watching movies or going for shopping, are at very low level because their access to transportation is very poor.

The interview result shows a uniformity in their answers as well as their life-style. It is predicted that once they will get the electricity, their life-style will show more variety. It should be noted that all villages have their generators, mostly 6 Hp (4.5 kW) type to supply electricity in the evening time. The running time is 2-3 hours/day in average during the interview period. However, condition depends on the economic situation of the family. These villages have already been electrified to a certain extent, and villagers know how to use electricity.

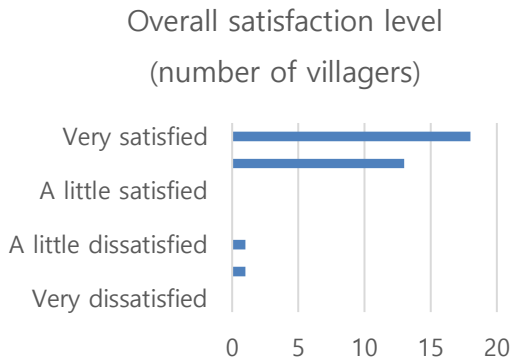

Figure 5: Overall satisfaction level of villagers

Figure 6: Satisfaction level in income

However, most of the villagers are keen to obtain electricity from renewables or the grid line, because of high cost of the fuel and maintenance of the generator. In addition, the generated power has been used only for lightings, fans, and TVs. Based on the interview, we noticed that there is almost no idea to use the electricity for business purpose.

This may be originated from their education level, limited accessibility of markets, and their living satisfaction. Menangkin, Tabong are in the process of being electrified through the extension of the power grid while a few houses in Jenggin have just been installed SHSs. Kampung Sungai Merah has not had any sophisticated electrification plan. Therefore, we decided to install SHSs at Kampung Sungai Merah in this project (Fig.4). The installed system included 5 SHS systems, each containing a PV panel, a solar charge controller, battery and an inverter. The specification of each component is listed in the Table 1. These parameter were selected to full-filled the total energy consumption of the whole village, 3.97 kWh/day. Two types of systems were used, one running on 12V battery the other uses 24V (two series connected 12V) batteries depending on the size of family. The total cost of the SHS system is about 6,000 USD excluding the transportation fee and the installation fee. We will continue the interview sessions for these villages to study how these different electrification schemes can affect the changes in their QOL. In addition to the QOL interview, the electricity consumption pattern will be monitored in a few families to understand how the rural electrification schemes change the way the rural communities consume electricity, and how the change in electricity consumption pattern is beneficial to the communities.

Table 1: Specifications of SHS components installed in Kampung Sungai Merah

Item	Specifications
PV Panel	305W, V_{mpp} = 37.8 V, I_{mpp} = 8.34A, V_{oc} = 45V, I_{sc} = 8.85 A
Battery	AGM sealed lead-acid battery, 12V, 150Ah
Inverter	Stand-alone type, 200W, Input: 12/24 V, 20/10 A_{max} Output; 230V 50Hz
Solar charge controller	PWM-type 12/24 V, 20/10 A

4. Summary

The aim of the project is to study the lifestyle, which will be measured by energy usage pattern and QOL, before and after rural electrification of rural communities in interior Sarawak, Malaysia. Through surveying the differences and/or similarities between the energy usage pattern and QOL of the villages under different rural electrification schemes, an effective approach of implementing rural electrification will be proposed. One of the most critical issues of the rural electrification scheme is always its sustainability. Over the years, many projects have been rolled out by the government or NGOs to provide electricity to rural communities, but a large portion of the systems tends to breakdown soon after the external support ended.

It is anticipated that the finding from this project can provide a better understanding of the impacts of rural electrification schemes to rural communities and methods to improve the sustainability of such schemes. We have conducted interviews in 4 rural Iban villages in

Sarawak, Malaysia, where several villages are not connected to the grid power. Two villages among them will be connected to the grid, one village has SHSs in partially, and we will install SHSs in the one village within this project. The QOL analysis shows that the lifestyle of the villagers is a typical monoculture style and most of them are satisfied with their lives even under low-income condition. We will continue the interview session for these villages to investigate how different electrification schemes will make different changes in QOLs and the pattern of the electric usage. We are also planning to increase the study site to obtain a good statistics and different renewable energy schemes.

References

Barns D.F., *Electric Power for Rural Growth: How Electricity Affects Rural Life in Developing Countries*, 2 edition, Energy For Development, 2014. ISBN-10: 0692303464

Becker, M.A., Shaw, B.R., and Reib, M.L., *QUALITY OF LIFE ASSESSMENT MANUAL*, 2014.

Brassley, P., Burchardt J., and Sayer K., Transforming the Countryside: *The Electrification of Rural Britain*, Routledge, United Kingdom, 2017. ISBN:978-1-4724-4127-0

Fadaeenejad M., Radzi M.A.M., AbKadir M.Z.A., Hizam H., *Assessment of hybrid renewable power sources for rural electrification in Malaysia*, Renewable and Sustainable Energy Reviews, Volume 30, 2014, Pages 299-305, ISSN 1364-0321, http://dx.doi.org/10.1016/j.rser.2013.10.003.

IEA, *World Energy Outlook*, 2002.

IEA, *Energy for all*, 2011.

Rahman SM and Ahmad MM, *Solar home system (SHS) in rural Bangladesh: ornamentation or fact of development*, Energy Policy 63 (12): 348-354, 2013.

Sim, T.T., and Khan, T.H., Reimaging Iban Longhouses in Urban Context: *A study in Sarawak, Malaysia*, Scottish Journal of Arts, Social Sciences and Scientific Studies, 2014, 3-10.

Stiglitz, J.E., Sen, A., and Fitoussi, J-P, Report by the Commission on the Measurement of Economic Performance and Social Progress, 2009.

UN, *Progress towards the Sustainable Development Goals*, Report of the Secretary-General Summary, Economic and Social Council, United Nations, E/2017/66, 2017.

UNEP, GNESD news, May 2006.

UNDP, *The energy challenge for achieving the millennium development goals*, 2005.

Urmee T., Harries D., Holtorf H-G., *Photovoltaics for Rural Electrification in Developing Countries*, p.12, Springer, 2016. DOI 10.1007/978-3-319-03789-9

van Gevelt T., Holzeis C. C., George F., Zaman T., *Indigenous community preferences for electricity services: Evidence from a choice experiment in Sarawak, Malaysia*, Energy Policy, Volume 108, September 2017, Pages 102-110, ISSN 0301-4215, https://doi.org/10.1016/j.enpol.2017.05.054.

World Bank, *The Welfare Impact of Rural Electrification: A Reassessment of the Costs and Benefits*, 2008.