

A STUDY ON THE EVALUATION OF SOLAR HOME SYSTEM VIEWED BY USERS -A CASE OF NOMADIC FAMILIES IN MONGOLIA-

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Here, we present the results of a questionnaire survey regarding Solar Home Systems (SHS) in nomadic families in Mongolia. The present study was performed to clarify user behavior, user satisfaction, problems, needs, and awareness of SHS by non-users. The survey was carried out in 67 nomadic families by the face-to-face questionnaire method, and 359 responses were received from nomadic families by the mail questionnaire survey method. From the results, most users indicated that they were satisfied with their SHS. They appreciated improvement in lighting and the ability to watch TV. It is shown that SHS is appropriate power system for nomadic lifestyle to compare with other type generation systems from the view point of users. The main problem for SHS users was a lack of after-sale service.

Keywords: Solar Home System, Electrification, Questionnaire Survey, Nomadic family

INTRODUCTION

By administration the Mongolia is divided in 21 aimags, which include 314 soums and the soums are divided in 1564 bags. About 43% of the total soums (about 135 soums) are not connected with the electricity transmission lines (off-grid soum). The national electrification ratio was indicated 67.3%, also nomadic family's electrification ratio was 17% in 2003. Power supply in the soums is at a considerably insufficient level in that diesel generators in the soums only allows 3 to 4 hour daily power supply because of difficulties in long distance fuel transportation due to bad roads and also because of instable, insufficient fuel supply to the soums due to shortage of funds to purchase fuel.

The government of Mongolia intends to improve supply power to off-grid soums by introducing sustainable and independent renewable energy with a focus on solar power in order to improve social services such as telecommunication, health care and education. As a part of this policy, the government is pushing forward with the "100,000 Solar Ger" Project to provide portable solar power systems (SHS) for nomads (Enebish, 2000) [1]. By this national project, 32,000 SHS sets introduced to nomadic families since 2000. On the other hand, actual condition of SHS use is less well understood in Mongolia and other countries (Nieuwenhout, 2001) [2].

In this study, the regional appropriateness of photovoltaic (PV) systems for nomadic families and villages in the arid and semi-arid land, were verified by the case study in Mongolia. As approach angle from technology, potential of solar energy resource, PV module performance by exposure test (Amarbayar, et al., 2006) [3], and the system performance of SHS (Amarbayar and Kurokawa, 2005) [4] based on 37 sites operation data in Mongolia, were evaluated.

From the social approach, we were investigated the questionnaire survey regarding SHS in nomadic families in Mongolia. This study is performed to clarify user behavior, user satisfaction, problems, needs, and awareness of SHS by non-users

ANALYSIS METHOD

The main purpose of the study was to collect information about users of the SHS, motivation for using the SHS, how SHS used, main problems occurring during the use of SHS, and service which is needed by users of SHS. The survey was carried out in 67 nomadic families by the face-to-face questionnaire method, and 359 responses were received from nomadic families by the mail questionnaire survey method.

Table 1. Category of questions

No	Questions category	Ques.Num
1	About the user of SHS	3
2	About motivation for using SHS	5
3	About the service of SHS	4
4	About the advantage of using SHS	2
5	Problem and demand	4
6	About satisfaction with SHS	2
7	SHS awareness of nonuser	4

The nomadic families from 6 prefectures (aimag) in the west, central, and southern regions (Khovd, Zavkhan, Bulgan, Dundgobi, Dornogobi, and Khentii prefecture) were chosen to be an investigation object of this research (Fig.1).

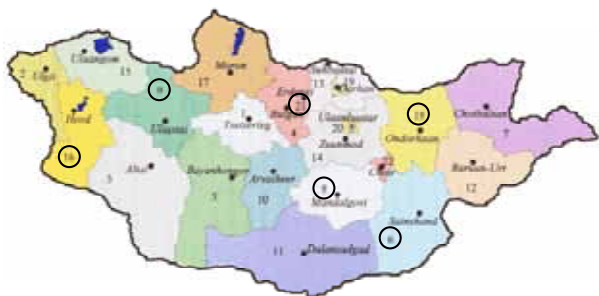


Fig.1. The object regions of questionnaire survey

Answers to questionnaire were collected 359 (Table 2). The response ratio of this survey was indicated low value (12%) to distributed numbers of questionnaire. Because, nomadic families move for pasture in every season, their location not undefined; this survey was costly and spend time, because the object were in special conditons. 359 answers are meaning in order to evaluate actual conditions and trend of user's consciousness.

Table 2. Responce conditions by the object regions

Province name	SHS user	Non SHS user
	by mail	face-to-face
Dornogobi	63	6
Dundgobi	27	-
Bulgan	45	37
Khentii	-	7
Khovd	117	-
Zavkhan	107	-
Total	359	50

Other hand, to examine the possibility of the introduction of SHS in the future, 7 items as the recognition extent of SHS and the purchase intention etc., were set to nonuser of SHS. The execution method was the face-to-face questionnaire survey method. The cooperation of the nomadic who was not using SHS was received from the nomad in the Bulgan province Khishigundur village (37 families), the Dornogobi province Sainshand villages (6 families), and Khentii province (7 families) in total 50 families (Table 2).

RESULTS OF ANALYSIS

Results of survey to SHS user

The ratio of four (28.7%) and five (25.7%) member's families are indicated high value (Table 7, Q1). As for the household income, ratios of 1 millionTg (94,000 yen) or less is high (Table 7, Q2). The nomadic families income of the this survey objects, is a low tendency compared with nationwide average annual income 1.24 million Tugrug (local currency, about 1,060US\$) in the households in the rural area (NSO 2004) [5]. It is assumed that the reason for this tendency is that the households of the civil servant and the company employee with high cash earnings are included in the households in the rural area.

Also, livestock numbers are the main indices of nomad's property. Generally, the nomadic family that owns 50 head of cattle or less is made the poorest family segment of the population and 150-250 with the interlayer (Jargal et al. 2004) [6]. The ratio of the SHS owner families that corresponds more than the interlayer is higher than that of the distribution of the cattle ownership number of nomads in the whole country by Mongolian Statistics Bureau (NSO 2004) [5].

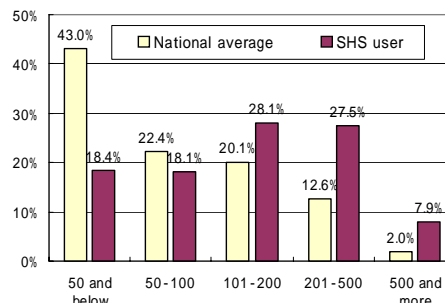


Fig.2. Number of cattle owned by SHS user

The price of the market for each single-unit of SHS is about 40,000 yen including 1 PV module (50W) and storage battery (12V, 75Ah) and the charge controller, etc. SHS is very large amount of money for the nomad whose average income during year is about 1.24 million Tugrug (NSO 2004) [5]. Therefore, the loan was executed for one interest-free year from 1999 in "100,000 Solar Ger" plan, and the subsidy of 50% of the delivery etc. was taken measures in 2003-2004. In the estimate of Mongolian Fuel and Energy Ministry, about 32,000 SHS has been introduced by April, 2005 (and by 2000 about 900 sets).

About motivation for using SHS

In the fig. 3 (Q4), 78% of the answer families bought SHS from "100,000 Solar Ger" project. The case bought from "Shop or market in the city" and "Door-to-door selling" was in total about 16%. The use period of SHS within 1 year, 2 years, and 3 years, more than 3years were indicated 30%, 41%, 24%, and 5%, respectively. From this result, it can say that the users with a little experience of SHS were the majority.

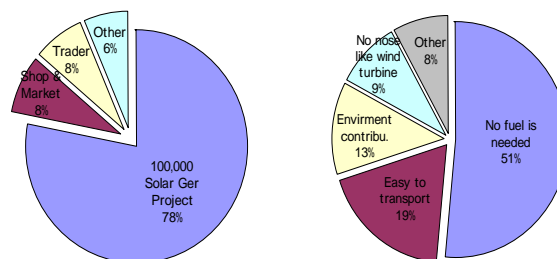


Fig. 3. Answers of the Q4 Where did you buy your SHS?, Q6 What was your motivation for using SHS?

The answers of not having used the power supply before use SHS, are 44%. Most of families (56%) have been used some power supply systems such as the gasoline generator, the wind power generation systems, and storage batteries, before using SHS, and their were

knows the convenience of electricity.

The motivation for introducing SHS were "It was using electrical appliances" (53.3%) in the meaning of demand to the convenience improvement of life, and next was "Neighbor used SHS" (21%). "The fuel was not needed" (51%) and "Easy to transport" (19%) became a hit to the reason to choose SHS from several types of power supply systems (Fig. 3, Q6). In the nomadic families that are uses the small gasoline generator, it is necessary to procure the gasoline fuel from a village center away on average at 60km regularly. Because the enormous expenditure needs in the fuel delivery to nomadic family, continuous use for the small gasoline generator is difficult and there is no delivery service.

Maintainance of SHS

From answers of Q10 "How many times did you have troubles?", 67 families (18.7%) experienced some troubles. The failure-prone parts of SHS are charge controller unit (32.2%), battery (29.7%) (Q11). When the SHS failed, users asks well known friend about electricity (54.6%) or repairs by themselves (29.4%)

Problems and needs of users

The main problem of SHS users it that there is no after sale service at all. First of all it because the "100000 SHS" project does not provide any service. As mentioned before about 70% of the families purchased their SHS from this project. For the private companies service will not be profitable because of the long distance and few customers.

Q15 Weak point of SHS? 1st: Expensive (48.9%), 2nd : Low power (22.7%). Q16 User needs for SHS? 1st: Repair shop in the soum center (39.1%), 2nd : Useful user manual for SHS (36.8%). Q18 About warranty and quality, 1st: To have long time warranty (61.0%), 2nd: Improvement of SHS parts (33.2%).

Main problem of SHS owners is lack of service. There is no service at all. They would like to have service shops in soum centers, shops where they can by spare parts for SHS, lamps and other small electrical equipment. At least they would like to have more information about SHS and introductions how to use and how to repair SHS. Many of them said that they would like to learn to repair SHS, so that they can help themselves and neighbors.

About the satisfaction with SHS

The most users (90%) indicated that they were satisfied with their SHS (Fig.4). They appreciated improvement in the ability to watch TV and lighting. Because, the answers of Q13 What is the advantage of using SHS were: 1st: The news, market info etc. on TV Broadcasting have been acquired instantly (53.3%), 2nd: The weather forecast is obtained in detail (22.9%). It is shown that SHS is appropriate power system for nomadic lifestyle to compare with other type generation systems from the view point of users.

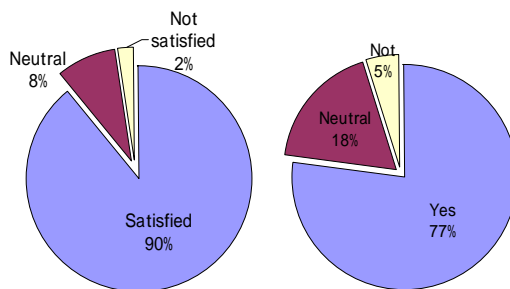


Fig. 4. The user satisfaction with SHS

Results of survey to non SHS user

In addition to this 50 families without SHS in Bulgan, Dornogobi and Khentii aimag were interviewed. 46% of them knows SHS well (Fig. 5, Q21) and 71% of them are going to buy SHS (Fig. 6, Q24). 31% of them would like to buy some power source, but they don't have cash (Fig. 5, Q23). Annual income and number of cattle of those 50 families is the same as the average of the 405 families below.

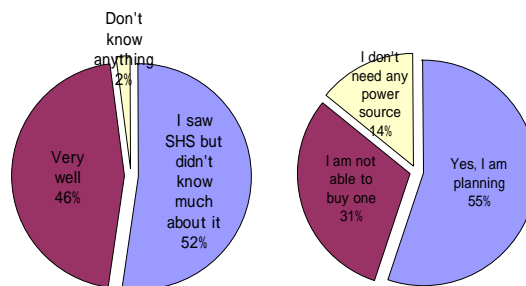


Fig. 5. Answers of the Q21 How well do you know SHS?, Q23 Are you going to buy some power source?

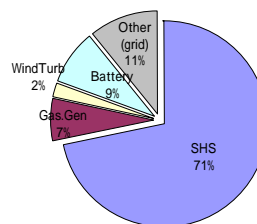


Fig. 6. Answers of the Q24 What kind of power source you would like to buy?

CONCLUSIONS

Here, we present the results of a questionnaire survey regarding Solar Home Systems (SHS) in nomadic families in Mongolia. This study was performed to clarify user behavior, user satisfaction, problems, needs, and awareness of SHS by non-users. The survey was carried out in 67 nomadic families by the face-to-face questionnaire method, and 359 responses were received from nomadic families by the mail questionnaire survey method.

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The electrification rate increased 18% at 5 years from 10.7% (in 2000), to 29% (estimation in Mart 2005) by implementation of the "100,000 Solar Ger" project. The main problem for SHS users was a lack of after-sale service. There is a requirement to establish service chains, review of preferential treatment for the sales and support system based on market principle.

References

- [1] Enebish, N.(2000) National Photovoltaic Program " 100,000 Solar House (GER) in Mongolia " , 28th IEEE Photovoltaic Specialists Conference, September 15-22, 2000.
- [2] Nieuwenhout, F.D.J. and Dijk, A.L. van, et al.(2001), Experience with solar home systems in developing countries: a review, *Progress in Photovoltaics*, Vol.9(DOI: 10.1002/pip.392)455-474pp.
- [3] A.Amarbayar, K.Otani, et al.(2006) Evaluation of Solar Energy Potential and PV module Performance in the Gobi Desert of Mongolia, *Progress in Photovoltaics*, Vol.14 (DOI:10.1002/pip.692) pp.553-566.
- [4] A. Amarbayar and K. Kurokawa (2005) Performance Analysis of Portable Photovoltaic Systems based on the Demonstrative Research Data in Mongolia, *Journal of JSES*, Vol.31 (168) No.4, pp.83-88.
- [5] NSO:National Statistical Office of Mongolia (2004) Statistical Year Book 2003, 141-147pp.
- [6] Jargal, G. and Y.Otgonbold, et al.(2004)Study Report " Bringing herders assets into full economic and productive use " , UNDP/SIDA, Ulaanbaatar, 31-33pp.
- [7] NEDO(1997) The New Energy and Industrial Technology Development Organization of Japan, "Demonstrative Research of Movable Type Photovoltaic Power Generation System" Overall Research Report, Kyocera Corporation, <http://www.tech.nedo.go.jp/Index.htm>
- [8] NSO:National Statistical Office of Mongolia(2004b) Statistical Year Book 1989-2002: " Mongolia in a Market System " , 163-165pp.
- [9] Nikolakaki, E.Krontiris(2001) "Problems and Prospects of Autonomous Power Plants with Small Scale Wind Turbines in Isolated Areas, Demonstration Project of Rural Electrification in Mongolia", International Conference Renewable Energies for Islands: Towards 100% RES Supply, Chania - Crete, Greece, 14-16 June 2001.
- [9] The New Energy Foundation (NEF)(2005) Report of questionnaire survey about installation quality of PV systems for House
- [10] Suzuki Yukio (2003) Actual condition of agriculture in Mongolia, *Science Journal Kagaku*, Vol.73 No.5, May 2003, 549-553pp.
- [11] Tserendash, S. (2000) Some policy related issues for pasture management, Newsletter No. 6 (38), Mongolian Academy of Sciences, Ulaanbaatar.
- [12] ADB(2002) Mongolia's Environment Implications for ADB's Operations, East and Central Asia Department of Asian Development Bank, PSNo.090602, ISBN 971-561-468-x.