

Survey on the Technical Durability of SHS in Rural Bangladesh



Survey: April 2008

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1 Executive Summary

In 2008, a study was conducted in order to examine the technical durability of Solar Home Systems (SHSs) in rural areas of Bangladesh. Based on a small sample of 75, this initial approach is aimed at providing an overview for larger follow-up studies which can reinvestigate the technical durability in a few years.

The study shows that all of the 75 surveyed SHSs are still operating.¹ The systems, purchased between 2002 and 2007 (50% of which were purchased in 2003), have a low rate of major problems. However, in the event of a major problem, it usually has been solved to the customers' satisfaction.

In addition to the numerous regular replacements, such as fuse and lamps, ten batteries have been changed and six customers have returned their old batteries to the non-governmental organization's (NGO's) office. In many cases, people want to sell their batteries by the time the batteries reach the end of their life-span. A plan is needed to guarantee an environmentally suitable disposal process for the batteries. In this regard, the system life-span and replacement procedures have not been sufficiently studied.

Out of the 75 people surveyed, only 15 customers had signed a maintenance contract. The remaining customers continue to pay the installments, therefore maintenance of the batteries is ensured. In other cases, customers did not have information about such an opportunity. It is recommended that awareness about maintenance contracts be raised in order to obtain a long-lasting operational time. Trainings for customers, which are offered by NGOs, have been successful; nevertheless, 40 percent of the customers share the opinion that they do not know enough to keep the system running. It has thus been deemed necessary to offer advanced trainings to further educate the customers on how to sustain the system.

In conclusion, it can be deferred that the vast majority of people are satisfied with the SHSs. As a result, people stated that if they were able to choose, they would choose to use SHSs rather than grid electricity or other electricity sources. However, a significant share of customers who use SHS along with grid electricity (3 out of 10) tend to choose the grid electricity over the use of SHSs. One respondent already substituted the SHS with grid electricity. Growing grid electricity supply and providing more voltage could have an impact on the use of SHSs.

Taking the comments of the people into account, one can say that there are some critical opinions regarding the overall capacity of the SHS, but most customers are satisfied and plan to run more appliances with their system.

¹ Except one SHS which has been substituted for grid electricity.

2 Introduction

The surveys' objective was to learn about the technical durability of Solar Home Systems, and to provide suggestions for further improvements of SHS services in the project areas. For this purpose, SHS users were asked about handling, costs and problems of their systems, as well as perceptions, suggestions and satisfaction.

Standardized interviews with 75 users of Solar Home Systems in rural areas of Bangladesh (Tangail, Comilla and Mawna District) were conducted in April 2008. About 60% of the participants were male.

People in the area are purchasing the SHSs with technical and financial support from Grameen Shakti and through micro-credit programs with other local NGOs. Infrastructure Development Company Limited (IDCOL), a partner of the German Technical Cooperation (GTZ), is providing support to these NGOs in order to promote the distribution process. The SHSs are gaining popularity, and they are being installed in rural homes, mosques and bazaars.

Based on a standardized questionnaire, quantitative and qualitative data was collected and analysed with standard analytical processes.² Furthermore, descriptive statistics were generated and discussed.

² See Annex

3 Sources of Electricity

All 75 surveyed SHSs are still operating, except one SHS, which has been substituted by grid electricity. In order to supplement the use of SHSs, some people use grid electricity and half of the people surveyed use dry-cell batteries. None of the people interviewed use diesel generators, storage batteries (such as automotive batteries), or buy electricity from their neighbour.

Ten people use SHS along with grid electricity; therefore, it is to be assumed that SHS is a useful backup system. In case of load shedding³, people benefit from SHS as an off-grid solution. Dry-cell batteries, which provide low power, are used for small household appliances. Therefore, they are not able to be considered a substitute for SHS or grid electricity. Presumably, on account of high operating costs, diesel generators are not used in the surveyed rural areas (see table 1).

Table 1: Sources of electricity available in the household

Electricity source	Electricity source currently used
SHS	74 ⁴
Grid	11 ⁵
Dry-cell batteries	31
Other electricity source ⁶	1

Source: Survey 04/08 (n=75; multiple response)

3.1 Current monthly expenditures for electricity

People use a variety of electricity sources to meet their demand. The technologies—SHS, grid electricity and dry-cell batteries—have different monthly expenditures, such as installation and transport costs. The amount spent by individual households on SHSs is so substantial that a detailed description is necessary. It was noted from our study, that there are still people who pay installment fees, which results in higher monthly expenditures, the average being 330 Taka⁷ for SHS, although half of these people pay 50 Taka or less. In comparison, paid off systems cost an average 23 Taka.⁸ Expenditures on grid electricity average out at 187 Taka per month, and it is only used in households that have already paid the installments for SHS (see Chart 1).

The average amount of money currently spent on dry-cell batteries by households is 18 Taka per month, with approximately 75 percent of battery operators paying 5 to 15 Taka.

³ Load shedding is used to monitor electric usage and shutting down certain electric loads

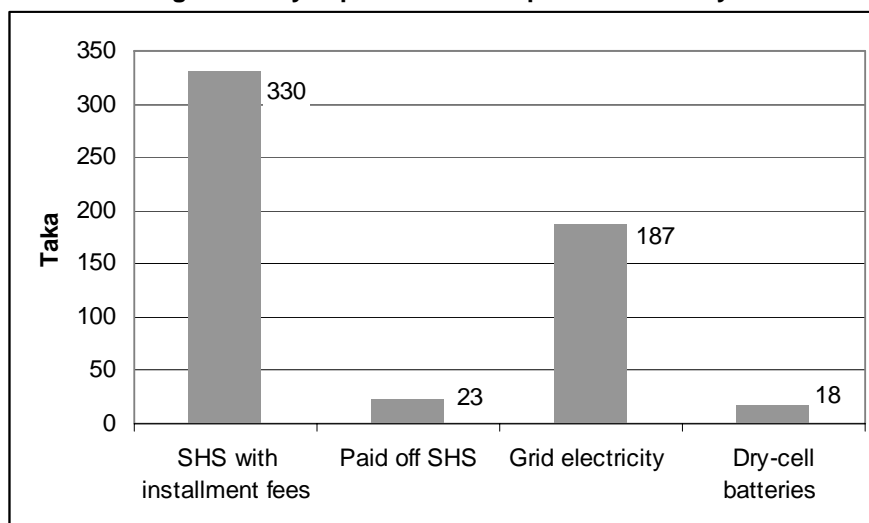
⁴ One person who was interviewed stated that he substituted the SHS with grid electricity because it provided him “more power”

⁵ Including the person substituted the SHS with grid electricity

⁶ Not specified

⁷ 100 Taka = 1,48 US Dollar (April 1, 2008)

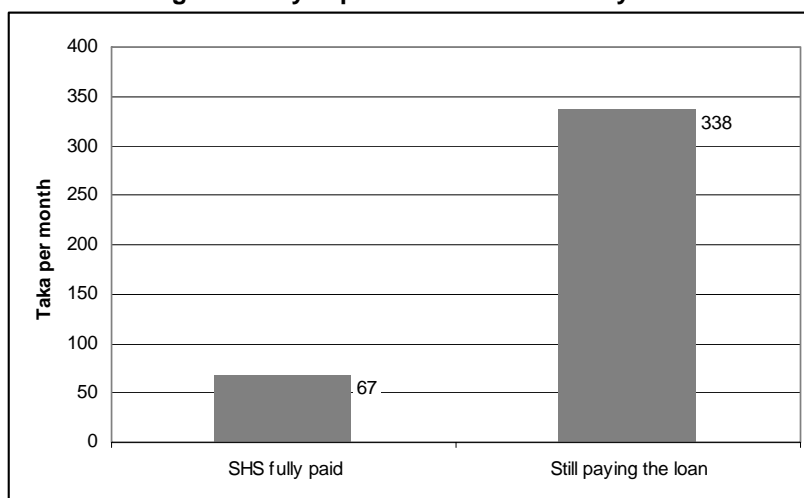
⁸ Except two significant outliers

Chart 1: Average monthly expenditures on specific electricity source

Source Survey 04/08 (n=72; multiple response)

The average expenditures on electricity, including SHS, grid electricity and dry-cell batteries by people who have completed their payments for the system are 67 Taka. On the other hand, people who still pay the installments spend on average 338 Taka for SHS and dry-cell batteries (see Chart 2).

It should be noted that there are a few fluctuations within the expenditures. In this regard, two outliers and the person interviewed who had substituted the SHS for grid electricity were removed and do not appear in the calculation.⁹

Chart 2: Average monthly expenditures on electricity¹⁰

Source Survey 04/08 (n=72; multiple response)

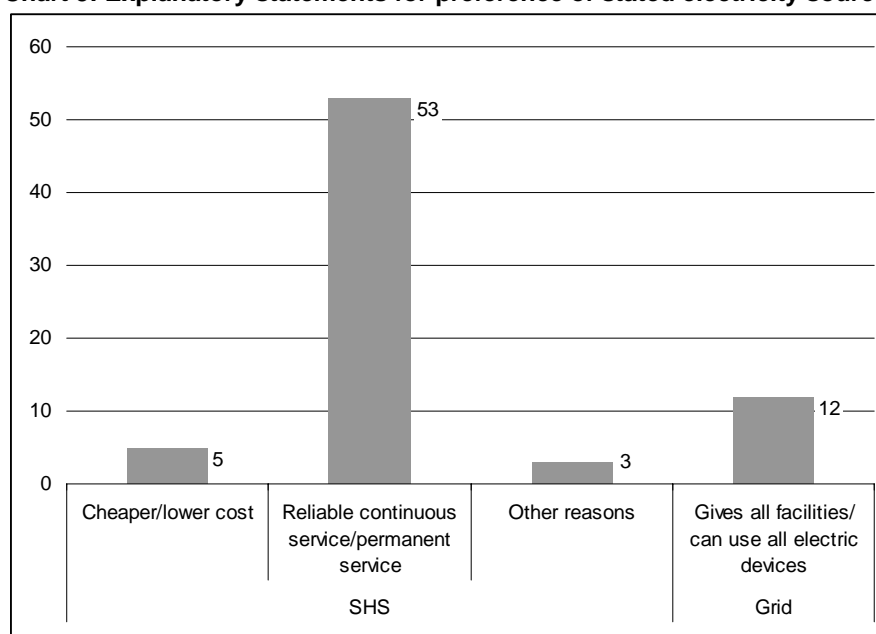
⁹ Their monthly expenditure is 340 Taka

¹⁰ Including SHS, grid electricity and dry-cell batteries

3.2 Preferred Source of electricity

About 16 percent (12 respondents) of the people interviewed said that they would prefer grid electricity if they had a choice as to the source of their electricity. As for their reasoning as to why they would prefer grid electricity, the respondents emphasized that all electrical devices can be used with grid electricity. The remaining 84 percent (61 respondents) said that they would choose an SHS system. The main reasons for choosing SHS are the reliable, continuous and permanent services. Thus the systems are widely accepted and the advantages are appreciated (see chart 3).

Chart 3: Explanatory statements for preference of stated electricity source



Source: Survey 04/08 (n=73; categories)

If given the choice, most people prefer the Solar Home Systems. In any case, a comparison of the answers of the respondents shows that the percentage of people who would choose grid electricity rather than SHS is higher among those that use SHS along with grid electricity. It seems as though the availability of grid electricity has had an impact on the choice of what type of electricity is preferred. It is likely that users have had good experiences with grid electricity, and they also value the technology which offers more power. If more people continue to get connected to the national grid system, the advantages of grid electricity might have a significant impact on the distribution of Solar Home Systems.

Table 2: Preference of stated electricity source based on used electricity source

Grid as electricity source	Preference of stated electricity source	
	Grid	SHS
No	8	56
Yes	4 ¹¹	7

Source: Survey 04/08 (n=75; categories)

¹¹ One person is only using grid electricity

4 Financing

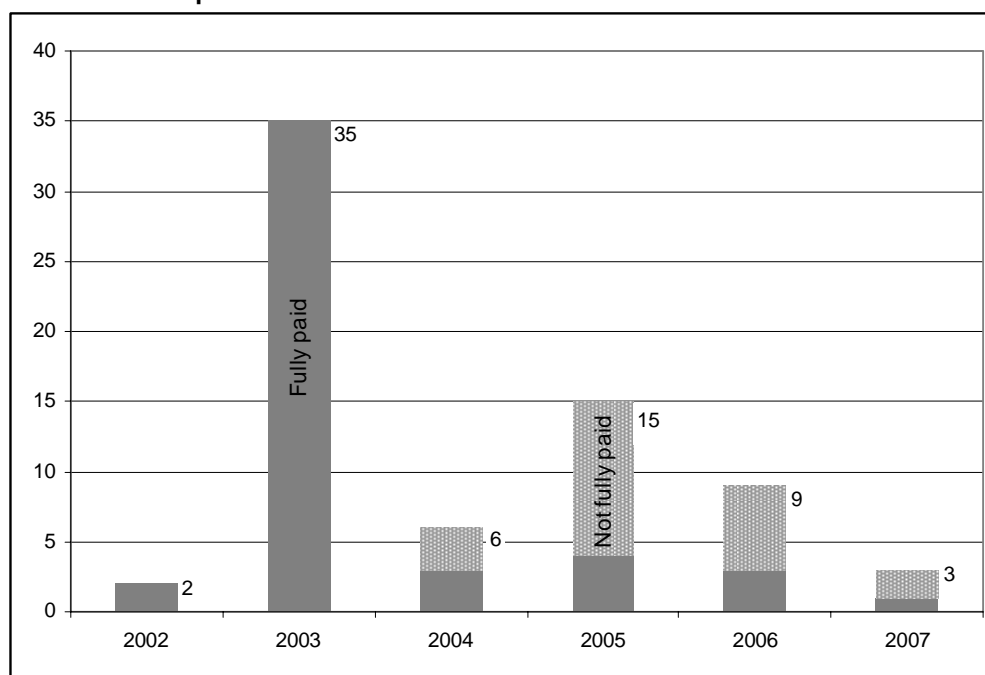
Half of all the Solar Home Systems were purchased in 2003. Five of the systems, which account for seven percent of the total amount of systems, were sold by the Center for Mass Education in Science (CMES) between 2002 and 2007. The other SHSs were provided by Grameen Shakti.

Of the systems purchased from the Grameen Shakti, almost half of them were purchased in 2003. This is a significant percentage which needs to be taken into account for the entire analysis.

Slightly more than two-thirds of all SHSs have been repaid. This figure includes all of the loans for the models from 2002 and 2003, which have all been repaid. In addition, all systems will be paid-off by the end of 2009. Monthly installment fees vary from 266 to 1247 Taka per month. One third of the households operating an SHS pay 700 taka a month. On average, people pay 636 Taka per month on installment fees. Of the 22 people interviewed, only four of the respondents claimed to have problems paying the monthly installments.

Nevertheless, it seems as though the monthly rates which are charged were set at the right level, however advanced findings about the terms of a loan are not available and more research needs to be conducted (see chart 4).

Chart 4: Year of purchase of SHS



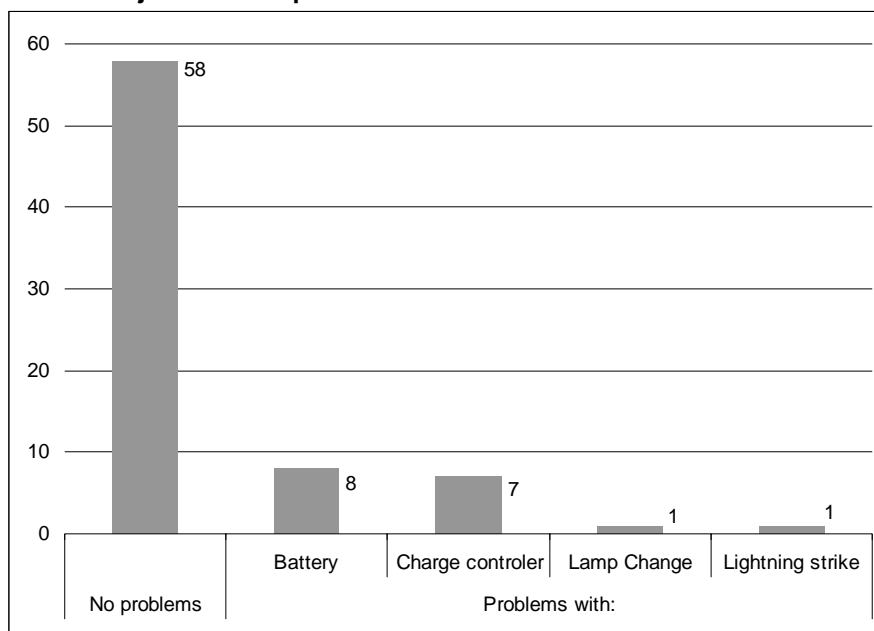
Source: Survey 04/08 (n=70)

5 Technical Durability

5.1 Challenges and replacement

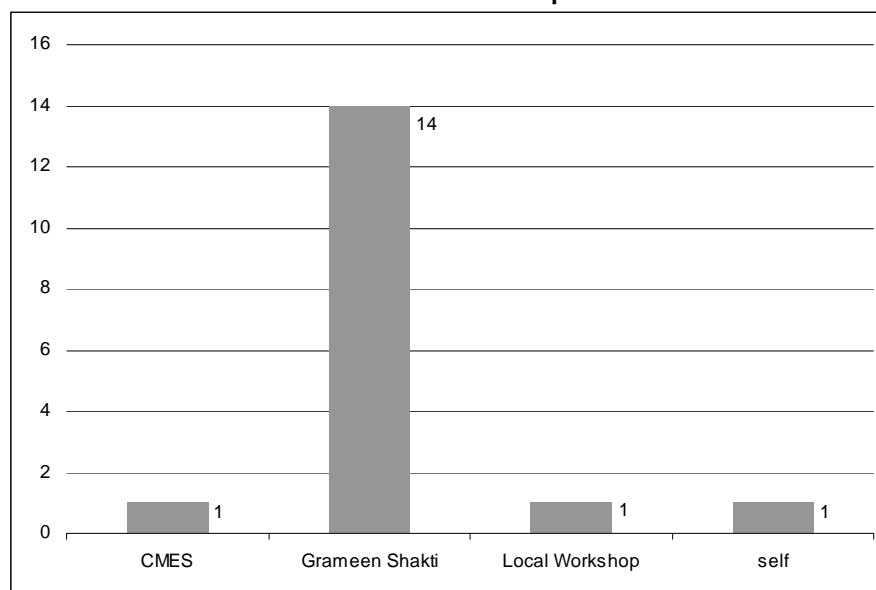
Fifty-eight respondents stated that they have not had any major technical problems. Thirteen out of the 36 systems which were installed in 2003 have had major technical problems since their initial operation. Systems which were built in 2002, 2004 and 2007 have not had any problems (see chart 5).

Chart 5: Major technical problems with SHS



Source: Survey 04/08 (n=75; categories)

Seventeen SHSs have been affected by problems. Of these 17 cases, 12 of them were solved to the customers' satisfaction. In most cases, it has been noted that the part that is the cause of the problem has to be replaced. A customer, who was dissatisfied with the repair, said that the problem was solved 12 months after the problem initially occurred. Another customer said there was nobody at Grameen Shakti who was able to assist him. As a result of the technical sustainability, the SHSs have a high degree of acceptance among their users. Solar Home Systems have a low rate of major problems, and the service system appears to function well. Due to the share and the age of systems built in 2003, these models have had the highest problems. Consequently, Grameen Shakti has made most of the repairs (see chart 6).

Chart 6: Staff who solved or tried to solve the problem

Source: Source: Survey 04/08 (n=17)

Replacement

Explanations about the wear and tear of parts is limited due to the number of replacements and the age of the systems. Nevertheless, the information about the replacements provides an overview on the topic (see table 3).

Table 3: Number of replacements of SHS parts since installation

Part	Number of replacements							
	0	1	2	3	4	5	6-10	>10
PV Panel	71	1						
Lamp	3	16	5	9	13	6	15	6
Charge Controller	62	9	2					
Battery	63	9	1					
Switches	52	10	7	2	1	1		
Structure	74	1						
Other part, such as fuse	56	4	1	1	1	3	4	2

Source: Survey 04/08 (n=75; multiple response; classified)

As a result of the different ages of the SHSs and the small number of replacements, it is difficult to generalize and draw conclusions about the lifespan of the SHS parts. However, information can be provided about the average life-span of parts which have already been replaced. Substantive data is available about the average life-span of lamps (12 months), but in general, these findings are understated.

It is assumed that parts such as charge controller, batteries and structure have a life-span of five years and more because half of the surveyed systems are built in 2003.¹² PV panels have an expected life-span of 20 years. In any case, the life-span of all parts and the replacement procedures has not been sufficiently studied (see table 4).

Table 4: First replacement after date of purchase

Part	First replacement after date of purchase (in month)			
	<6	7-12	13-23	>24
PV Panel	1			
Lamp	21	29	12	8
Charge Controller	1	3		7
Battery	2	1		7
Switches	5	6	2	8
Structure	1			
Other part, such as fuse	8	5	2	3

Source: Survey 04/08 (n=75; multiple response; classified)

5.2 Battery issues

Batteries are a critical component of an SHS; however there is little knowledge about their life-spans, the disposal process or the willingness of the people to buy new ones in case of replacement.

Ten batteries have been changed, of which, seven were installed in 2003 and three installed in 2005/2006. The latter three were replaced within the first year of operation. Two of them were changed in the first month of operation, which means that the customers likely utilized the warranty. The seven batteries which were installed in 2003 had an average life-span of four years. Since many batteries have not been replaced, it can be assumed that the life-span is more than four years. The basis for this data is limited and the systems are still young. Further findings are expected by the time all batteries have been replaced.

Seven people interviewed submitted specifications on the price of their battery. The price that the respondents pay for the disposal of the battery varies. Of the seven people who responded, three of them got a free, new battery. It is assumed that one of these batteries was replaced during the warranty period; however it is still not known why the other two respondents stated that they paid nothing for a new battery, since those batteries were replaced after four years. The other four customers who bought their new battery paid 4,000 to 11,600 Taka; the average amount paid being 7,900 Taka. The fact that people replace or are willing to replace (66 out of 66 who answered this question) the battery, even though they are quite expensive, must be seen as a sign that the SHSs provide great benefits and that customers are very satisfied.

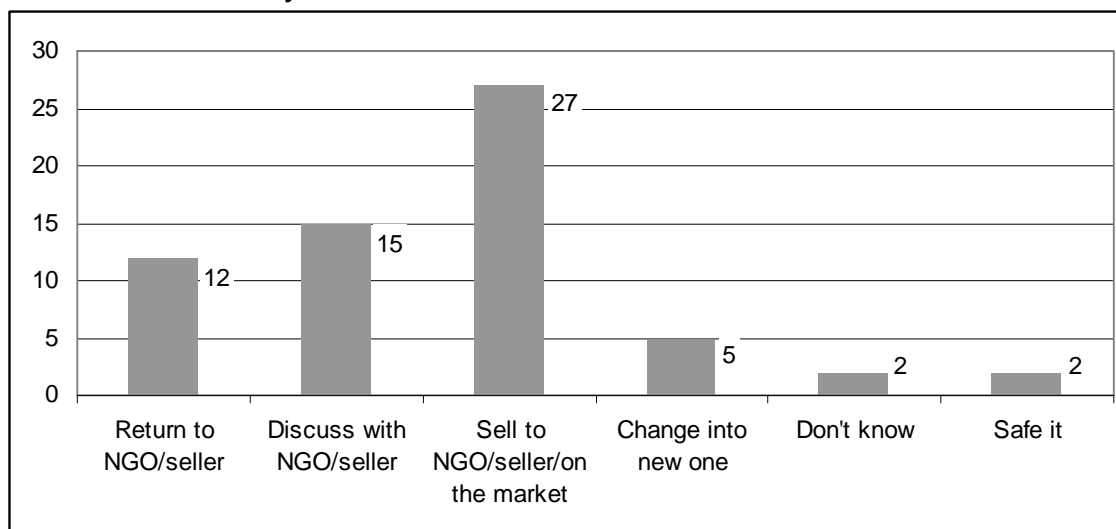
Most people want to sell their old batteries; however some people want to return them to the NGO, while others are not sure how to dispose it. Six people, who changed the systems'

¹² One SHS was hit by a lightning strike, which damaged almost every part (PV panel, structure etc.)

battery, returned the old battery to the NGO office. Unfortunately, four other people who replaced the battery did not answer this question (see chart 7).

Concerns have been raised that people are improperly disposing of the batteries. The improper disposal of the SHS batteries can cause a substantial amount of damage on the environment, as well as human beings. It is assumed that private recycling companies in the informal sector are not professional. Due to these environmental threats and the general intent to sell old batteries, it is necessary to make arrangements to guarantee an environmentally suitable disposal process.

Chart 7: When the battery of your SHS has reached the end of its life-span, what are you going to do with the old battery?



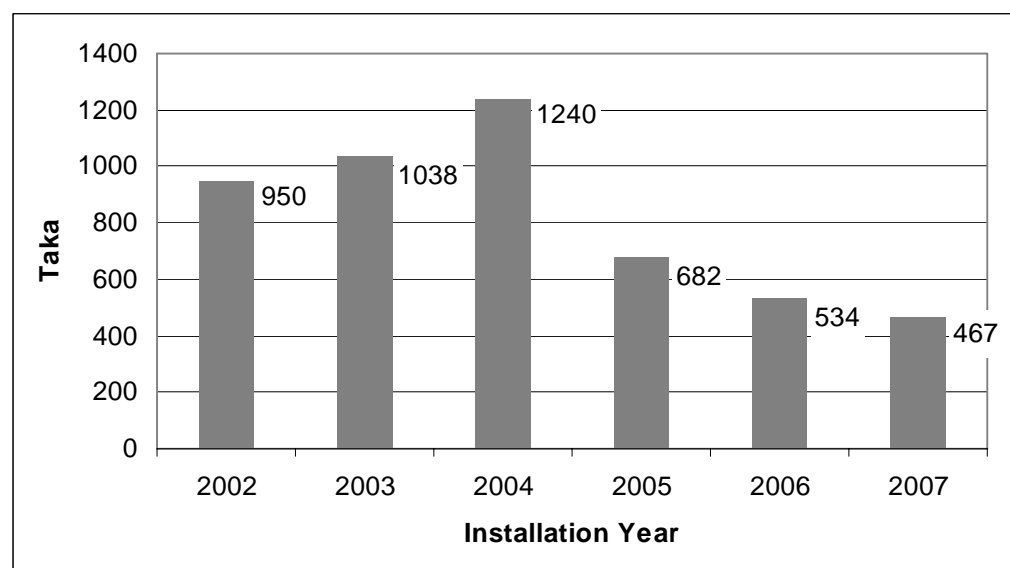
Source: Survey 04/08 (n=63; categories)

Most people (86%) fill their batteries up with distilled water, while three percent used rain water. About 11 percent of the respondents did not refill the battery. This indicates that the instructions and trainings which were provided prepared the people well for the maintenance of the batteries.

5.3 Maintenance

Maintenance is critical to obtain a long-lasting operation time. Chart 8 shows the average maintenance expenses since the installation of the systems. The expenses vary by the age of the models. Since older systems have a longer operation time; this leads to increased costs due to wear and tear.

Chart 8: Average maintenance expenses depending on the year of installation



Source: Survey 04/08 (n=70)

The maintenance work is primarily performed by NGOs. Some customers choose to do the maintenance on their own, thereby allowing them to reduce maintenance expenses (see table 5). However, conclusions about at home maintenance are not possible. For individual cases, further research about maintenance costs is recommended.

Table 5: Maintenance work

Responsible for maintenance	Count	Col %
Family member	10	16%
Self	6	10%
NGO	46	73%
Nobody	1	2%

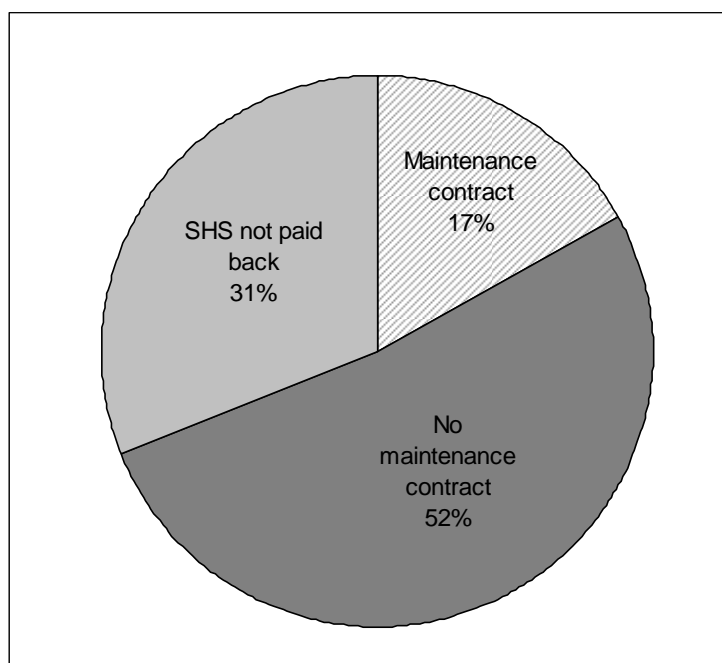
Source: Survey 04/08 (n=63; categories)

Of the people surveyed, twelve of the respondents (17%) had signed a maintenance contract. One third of the customers (22 people) still pay the instalments (31%), thus maintenance is ensured; while other 37 people (52%) had no maintenance contract. Customers who signed a maintenance contract pay 300 Taka per month. For the customers who did not sign contracts, several reasons were given. In many cases, customers maintain the system on their own as they developed the knowledge and skills to do so in the user

trainings. Thirteen people did know about the maintenance contracts, while others did not have any problems yet. Some customers responded that they are not interested in a maintenance contract or claimed that they have no need for such a contract.

In order to promote the opportunity of maintenance contracts, their availability needs to be advertised.

Chart 9: Maintenance contracts

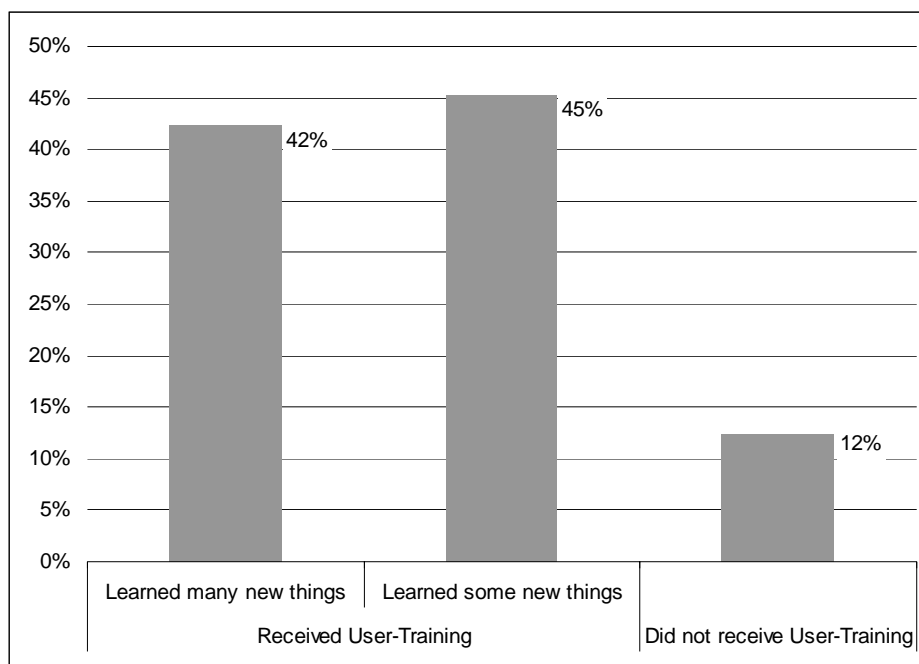


Source: Survey 04/08 (n=71)

5.4 Advanced training

Twelve percent of the respondents said that they did not received a user training the rest are satisfied and answered that they learnt many or some new things related to maintenance of a SHS (see chart 10). Most people stated that they learned how to change the lamp, the battery water and the fuse in their advanced training. Approximately 60 percent of the people interviewed said that their household knows everything that is necessary to use the SHSs and keep them running. The remaining households stated that they needed to learn more about their SHS in order to use it properly. In particular, the customers are interested in technical aspects related to batteries.

Overall, previous trainings were successful. In any case, 40 percent share the opinion that they do not know enough information to keep the system running. To increase the customers' knowledge about SHS maintenance, more training needs to be offered.

Chart 10: Households that received a User-Training and evaluation of learning outcome

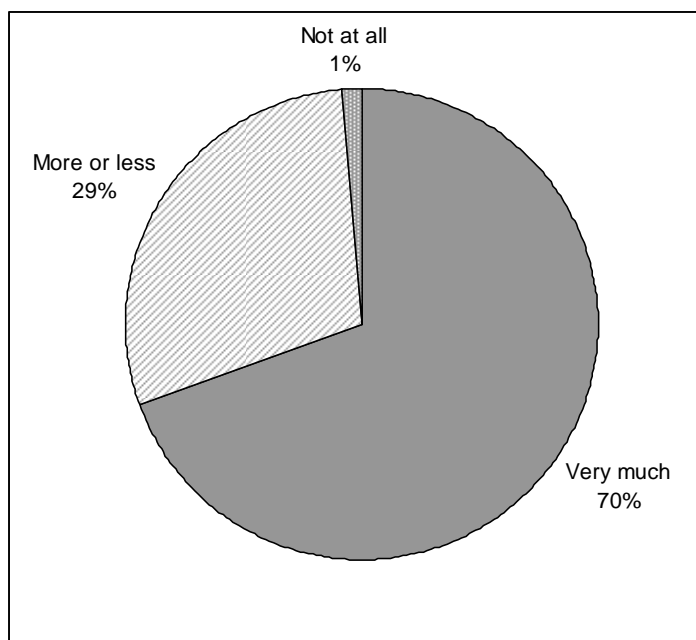
Source: Survey 04/08 (n=73)

5.5 User Satisfaction

Seventy percent of the SHS-Owners are very satisfied with the system and 29 percent are “more or less” satisfied. Only one percent of the respondents are not satisfied (see chart 11). People who stated they are more or less or not at all satisfied with their systems mentioned that the system does not provide enough power; therefore it is not possible to use a fan and a colour television. Nevertheless, 92 percent (69) of the respondents would recommend an SHS to relatives, friends, neighbours, etc. The same respondents said they would recommend the system because the ease of running the system and the affordable costs. Furthermore, other respondents said that the system is independent and always working, therefore, negative aspects of load shedding which is very common in the national electricity grid can be avoided.

The statements indicate overall satisfaction with the system. Some of the statements mentioned could possibly be added to the SHS marketing program.

The high demand for more powerful systems needs to be taken into account. It seems as if there is an urgent need for action to increase power. The system size and performance need to be competitive to grid electricity in order to achieve a long-lasting operation time, even though the household will be connected to grid electricity.

Chart 11: Satisfaction with the SHS

Source: Survey 04/08 (n=75)

When asked about improvements, 93 percent of respondents said that the power of the system should be increased.

Table 6: Improvements

Suggestion	Count	Col %
Increase system power	66	93
no answer/don't know	3	4
other ¹³	2	3

Source: Survey 04/08 (n=71; categories)

Taking the responses of the people into account, one can conclude that there are some critical voices regarding the overall capacity of the system, but most customers are satisfied and plan to run more appliances such as televisions and fans (30 households) with their systems.

¹³ Cheaper system, improved battery system

6 Summary of Recommendations

Taking the comments of the people into account, one can say that there are some critical opinions regarding the overall capacity of the SHS, but most customers are satisfied and plan to run more appliances with their system.

- If more people continue to get connected to the national grid system, the advantages of grid electricity might have a significant impact on the distribution of Solar Home Systems.
- Of the 22 people interviewed, only four of the respondents claimed to have problems paying the monthly installments. Nevertheless, it seems as though the monthly rates which are charged were set at the right level, however advanced findings about the terms of a loan are not available and more research needs to be conducted.
- Due to these environmental threats and the general intent to sell old batteries, it is necessary to make arrangements to guarantee an environmentally suitable disposal process.
- 37 people (52%) had no maintenance contract; In order to promote the opportunity of maintenance contracts, their availability needs to be advertised.
- Twelve percent of the respondents said that they did not received a user training; 40 percent share the opinion that they do not know enough information to keep the system running. To increase the customers' knowledge about SHS maintenance, more training needs to be offered.
- The high demand for more powerful systems needs to be taken into account.

Annex 1: Focus Group Discussion

Conducted by Syed M Latif

1. Introduction

Focus Group Discussions (FGD) with the users of SHS in rural areas of Bhutulia and Goldapara villages in Mawna were held between 22 and 27 April 2008. The objectives of FGD were to know the technical durability, advantages, drawbacks and suggestions for further improvements of the SHSs electrification services in the project areas.

The rural people of Bhutulia and Goldapara villages are using the SHS since 2005-2006. People in the area are purchasing the SHSs with technical and financial support from Grameen Shakti and other local NGOs through micro-credit facilities. The German Technical Cooperation (GTZ) is extending support to these NGOs to promote such dissemination process. The SHS is getting popular in the area and these are installed in houses, mosques and rural bazars.

2. The Consultation Process

Between 22 and 27 April, several FGD meetings on the SHS sustainability and other technical and social impacts of the project was held at the Bhutulia and Goldapara villages in Mawna. The meeting was organized by the Grameen Shakti in collaboration with the rural people.

Over 10 people participated in the meeting, among which farmers, traders, school teachers, students and women were present.

The agenda of the FGD meeting was as follows:

- (i) opening discussions by the Survey Contractor (about 15 minutes),
- (ii) group discussions about technical, financial, availability of parts and overall support extended by the NGOs.
- (iii) discussion and questions about SHS sustainability issues with participants.

The FGD focused on the socio-economic changes of the people's lifestyle that is observed using electricity from SHS. These changes are mainly improvement of household income (carpenters work in the evening using the SHS electrification), continue trading and other business in the rural markets, watching TV and education facilities for the students.

3. Summary of Discussions

1. The rural people are now habituated in using the SHS, and this has become a part of their life.
2. Technically the use of SHSs are safe compared to Grid supply
3. The NGOs should supply the SHS at a lower cost, because the poor people cannot afford the system.
4. There is a need to ensure safety of the SHS components at the time of cyclone, as one system burnt following a cyclone in Goldapara village.
5. People desired to increase the capacity of the SHS to watch color TV, use fan and refrigerator.
6. In general, the users of the SHS realize that the used battery will be returned to the NGO office but some people told that they will sell the battery to the vendors.

7. One client in Shakipur village in Tangail complained that the battery was replaced within the warranty period but they had to pay money. This should be further investigated to identify the corruption if any.
8. There is a need to increase the management efficiency of the NGOs to establish quick contact and efficient service to the clients.
9. The SHS is getting popular, the number of clients are increasing day by day, as the grid supply involves load sharing and causes annoyance.
10. After the warranty period, customers are interested to go for a maintenance contract with the NGOs for ensuring quality service.

Annex 2: Questionnaire